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THE AGRICULTURAL GEOGRAPHY of the DECCAN PLATEAU of INDIA

BY

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WITH AN INTRODUCTION BY

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ILLUSTRATED BY 28 MAPS AND GRAPHS

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AUTHOR'S NOTE.

In presenting this monograph, I should like to tender my thanks to all who have helped me in the preparation of it ; to Professor Roxby of Liverpool for his great help and advice throughout ; to Dr. H. Mann, Director of Agriculture for the Bombay Presidency, for his valuable help and criticism, and his kindly interest in the work ; to Mr. J. Fairgrieve for his great assistance in the preparation of the work for publication ; to the officials of the India Office for the facilities which have been granted for obtaining the material on which to work, and particularly to Mr. G. F. Tinney, late Head of the Record Department for the facilities which he afforded me when working there ; finally to the Departments of Agriculture in Bombay, Madras, Central Provinces and Mysore, and the Indian Meteorological Office, Simla, who have kindly replied to my enquiries and furnished me with much information.

The scope and aims of the study are very fully set forth in the introductory note by Professor Roxby, under whose guidance the work was undertaken and completed.

ETHEL SIMKINS,
Cardiff, 1926.

INTRODUCTORY NOTE.

The treatment of agricultural activities and distributions on a scientific geographical basis, which was foreshadowed by William Marshall more than a century ago, has become an important branch of investigation in recent years, as is evidenced by the publication of such works as the Atlas of the World's Agriculture and the Agricultural Atlas of England and Wales. It forms a fruitful line of research in several University Schools of Geography. It is more particularly helpful in the case of a country like India whose vast peasant population depends for its maintenance and well-being on the factors analysed in the following pages. Increasing importance is attached to the investigation of such problems as the precise character and incidence of monsoonal rainfall in relation to agriculture, the relationship between "subsistence" and "commercial" crops and the effects of industrialism on agrarian conditions. This monograph, the substance of which was prepared by Miss Simkins as a thesis for Part II of the Honours Examination in Geography at Liverpool University in 1924, is a systematic attempt to relate the different types of crop associations and rural economy in the Indian Deccan to particular rainfall regîmes and soil conditions and also to discuss the social phenomena arising therefrom in their proper environmental setting.

The materials for this study, if not complete, have been abundant, thanks to the courtesy of the India Office and of several other public departments to which application was made. In particular, Miss Simkins and myself are greatly indebted to Dr. H. H. Mann, Director of Agriculture in the Bombay Presidency, for his warm encouragement and help. While the work was in progress he supplied some valuable data, and after its completion, he was kind enough to discuss it in detail and to make some suggestions which have been adopted in the final form in which it is now presented.

PERCY M. ROXBY,

November, 1926.

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INTRODUCTION.

THE SIGNIFICANCE OF AGRICULTURE ON THE DECCAN.

The study of the Agricultural Geography of the Deccan, is the study of the basis of practically all life in the region ; the sons of the Deccan are tillers of the land, and on the return it gives them for their labours they must live. It typifies conditions in India as a whole. " The total population of India is 315 millions, and 75 per cent. of this population is supported by agriculture. Totally there is less than one acre of cultivated land per head of the total population, and not more than $1\frac{1}{4}$ acres per head for the population which is directly supported by agriculture. Not only does the land of India provide for this great population, for, with the exception of sugar, no food is imported from other countries, but a very considerable portion of it is set apart for growing produce which is exported. India supplies the whole world with jute ; its cotton crop is the second largest in the world—it sends abroad large quantities of rice, wheat and oil seeds—in fact, it pays its bill for imports of merchandise and treasure, and discharges its other international debts mainly by the sale of agricultural produce. Subtracting the area thus utilised for foreign markets from the total area under cultivation, we shall find that what is left over does not represent more than 2/3 acre per head of population. India, therefore, feeds and clothes its population from what 2/3 acre per head can produce. There is probably no other country in the world where the land is required to do so much."[1]

It is the object of this study to see how the land of the Deccan fulfils its obligations to its cultivators. Firstly, to analyse the physical basis of the region, its soils and its climate, as determining its productive power, and to survey the production of the region in view of these factors. Next, to trace the influence of the physical factors on the agricultural settlement of the region, and, taking these physical and human factors, together with the modifications wrought in them by the West, with its roads, railways, irrigation works, commercial cropping and industry,to analyse the Rural Economy of the different " production regions " or " crop associations." Finally, to show the result of all the factors operating, as reflected by the distribution of population.

CHAPTER I.

PHYSICAL FACTORS IN DECCAN AGRICULTURE.

I.—PHYSICAL HISTORY AND GEOLOGY OF DECCAN PLATEAU.

For the purposes of this study the Deccan plateau has been taken as the triangular mass of highland bounded on the West by the Western Ghats, on the East by the Eastern Ghats, and with its apex at their junction in the Nilgiris. On the North it is limited by the Satpuras and their continuations the Mahadeo and Maikal ranges ; the North Eastern boundary of the plateau is taken as the watershed between the Mahanadi and the Godaveri rivers The Mahanadi basin has been excluded from this study for several reasons.

1 Provincial Census Report India, 1921.

First, it drains a region orientated to the Bengal region in its economic life rather than to the Deccan, from which it is shut off by the rugged forested country of Bastar and Vizagapatam. Secondly, the basin comes within the region of heavy and certain rainfall typical of the Lower Ganges valley, and entirely different from the uncertain scant rainfall of the Deccan plateau. Since rainfall is the primal factor of agriculture on the plateau, the Mahanadi basin differs from the plateau in this respect, and has thus been excluded from the study of its agriculture.

The region thus comprised consists of a tableland some 2,000 feet high, of which the rims, which range from 3,000 to 6,000 feet, are the Western and Eastern Ghats. The Western Ghats are terminated in the north by the Tapti valley, and are generally low and broken north of the latitude of Poona. South of Poona they are high and unbroken as far south as the latitude of Belgaum where an extensive break occurs. The range regains its height again in Northern Shimoga, and from here to the Nilgiris, in which part it forms the western boundary of the Mysore plateau, it is a high, wide, unbroken, mass of forested mountain country—much more formidable than to the North. The range culminates in the Nilgiris at nearly 9,000 feet.

The Eastern Ghats do not exist as a continuous mountain range. They are low and broken highlands, stretching from the Nilgiris to the mountain country of Bastar, with wide gaps where the easterly flowing rivers debouch on to the wide coastal plain.

To the North, the Satpuras and Mahadeo hills are relict mountain ranges, as a result of long denudation.

The plateau within these rims is one of the oldest land masses of the world, once part of the mighty Gondwana continent stretching through the southern Seas. It has been a land surface since Cambrian times, and shows all the features of age long weathering, having wide open valleys and easy slopes for the most part. It has a gentle tilt to the east. The plateau is crossed by many spurs of the Western Ghats in a west-east or a north-west south-east direction, but only one, that through Central Hyderabad, extends across the whole breadth of the peninsula.

The plateau attains its greatest height in Mysore—which is a tableland at an elevation of 3,000 feet, broken by countless rugged ridges, particularly in the West.

This old land mass is very simple geologically (See Fig. 1) being composed primarily of old metamorphic schists and gneisses corresponding to the Lewisian and Huronian rocks of Scotland and North America. These comprise all the plateau south of the Kistna and all Eastern Hyderabad and the Eastern Central Provinces ; they are characterised by rugged rolling country, with isolated bare hill masses, and extensively covered with forest or jungle where not cultivated.

In parts of the peninsula Paleozoic rocks occur. The Cuddapahs, which represent this age of rock on the Peninsula, are an ancient series of sedimentary strata, derived from the old archaean rocks, and consist primarily of shales, slates and limestones. They overly the archaean rocks in a small area in South Maratha country between the trap and the archaean rocks, extending along the Kistna river from its junction with the Gatparba, westwards to pass underneath the trap of the Western Ghats. A more extensive occurrence is in Eastern Madras, where the rocks extend along the Kistna valley from its

junction with the Tungabhadra, to its debouchure on to the east coast plain. Its eastern boundary is the Eastern Ghats, and its western boundary overlooks the gneissose rocks of Mysore and Bellary. It extends southwards as far as Tirupatti 30 miles north-west of Madras, and its core is the Nallamallai Hills.

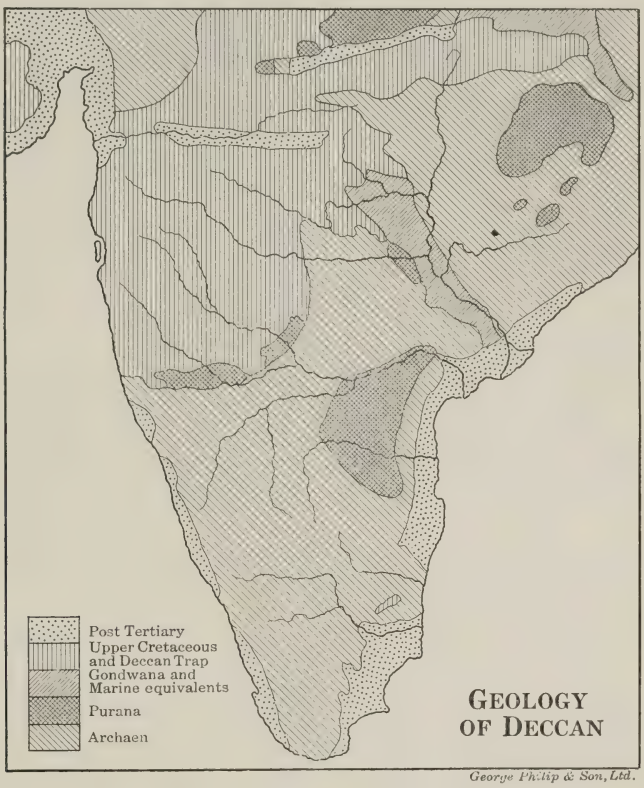


FIG. 1.

The next age of rock represented on the plateau is found in the Gondwana series, dating from Upper Carboniferous to the end of Jurassic. These are fresh water sandstone deposits yielding poor gravelly barren soils. The system is preserved on the plateau in the valley of the Godaveri only, up which it extends as far as the junction of the Wharda and Penganga rivers. It is thought to have been deposited on the surface of the old Gondwana continent, and preserved in the slowly sinking faulted trough of the river. It is the main coal bearing system of the plateau.

The final geological era represented, exclusive of the alluvial deposits, and the most striking of the plateau, is that of the Deccan trap of Lower Cretaceous and Eocene times. This consists of vast horizontal sheets of basaltic rocks, which cover in all 200,000 square miles, extending from the Bombay coast as far south as Malvan, inland as a continuous sheet to Central Hyderabad. From here the eastern boundary bends northward, crossing the Manjra River a little to the west of its junction with the Godaveri, then continues as far north as the Penganga, whence it bends eastward and runs along the south bank of that river almost to its junction with the Wharda. From here it bends north-east and crosses the Wharda Valley. Midway

between the Wharda and Wainganga it turns north-west running just to the east of the town of Nagpur. Thence it continues to the Mahadeo hills, and bends east to include the Maikal Range as far as the headwaters of the Rehr river. Its northern boundary is indefinite. In the eastern part it is chiefly south of the Vindhyan scarp, but on the west it is continued northwards to cover part of the Malwa plateau. Large tracts are also found in Kathiawar and Cutch, and numerous other small outliers indicate that it once had a far greater extension than at present. The beds thin considerably at their limits. On the Bombay coast the depth is about 10,000 feet ; it decreases to 500 feet at Amarkantak at the eastern limit, and 100-200 feet at Sind in the west. The cause to which this basaltic covering is attributed, is a great out welling of lavas through mighty earth cracks, in late Cretaceous and early Tertiary times. The breaking away of the Deccan plateau from the Gondwana Continent in this period is probably connected with these disturbances,[1] since such crustal movements are generally associated with volcanic activity. The lavas spread themselves out over this vast area in horizontal sheets, obliterating all previous scenery, and giving to the region, by their curious weathering, the distinctive scenery known as " Trap " Country. This exhibits extensive monotonous levels, broken by flat-topped, steep-sided hills, often terraced up their sides, and generally bare of all vegetation save coarse grass. The *regur* or black soil of the Peninsula is particularly associated with this trap country. The general scenic effect affords a striking contrast to the rolling, rugged, wooded country of the metamorphic regions, and the distinction between the two types seems to be maintained in every aspect studied—physical, human, and economic.

Since these early Tertiary disturbances the peninsula has suffered no movements such as affected the Himalayan region of North India. It has been a stable land mass subject to continuous weathering.

II.—SOILS OF THE DECCAN PLATEAU.

The main aspect of soil study on the Deccan plateau is the relative productivity of the different soil types. This degree of soil productivity, however, is not determined solely by the soil itself, factors of climate and position enter very largely into any consideration of soil productivity. A soil may be quite useless under some climatic conditions and of first class productivity under others, hence, a study of soils in relation to production, necessitates the correlation of climatic and topographical factors with soil type.

The return a soil gives to its cultivation depends upon its power to supply to the plant its requirements for successful growth, water, food, and fixation. The texture of the soil is the main factor in determining its power of retaining and conducting moisture ; this is a vitally important consideration on the Deccan where most of the soils receive four to five months rainfall at one period of the year. The retentivity of the soil depends on the size of its particles ; a large grained soil will be necessarily loose in texture, and the water will either sink through rapidly, and drain away out of reach of the plant, or be evaporated before it has had time to do this. The finer textured soils are able to retain their moisture for a much longer period—hence their value on the Deccan. The degree of capillarity, which greatly influences the availability of the water in the soil to the plant roots, is also determined by texture. If the water sinks through to a great depth in the soil, and thus lies beyond the root range of the plant, it is of no use to the plant unless the

1 Wadai " Geology of India," 1921.

soil is of fine enough grain to provide effective capillary tubes. A loose grained soil is practically useless under such conditions. Also, to be considered is the friability of the soil—its working properties, and its powers of permitting fixation and penetration by the plant roots. A very heavy soil is at all times more difficult to work than a light soil, but the attributes of soils in this respect vary greatly with the seasons. Heavy clay soils during a hot period with no rain, may become so hard baked that plants find it impossible to exist in them during this period, and under heavy rainfall they may be too heavy and sodden. The lighter soils tend to be too friable and dry under hot rainless conditions, but are at their best in the wet seasons,when frequent and not too heavy rains constantly renew the water in the upper layers of the soil, and weld the particles together. Very heavy rainfall is detrimental in that it serves only to scour a light soil, and the excess water is only wasted, whereas a heavy soil is able to utilise a heavy shower by storing it up for use in a dry period. The importance of a heavy soil in a region like the Deccan, where the rain often comes in down-pours, and is followed by a long break, is evident. This is particularly important since the weather during these breaks is very hot and dry. A high temperature and a dry atmosphere mean rapid evaporation from the soil, and rapid transpiration from the plants growing in it, hence there is much water lost from the soil. Evaporation takes place most easily when water is near the surface, hence the deep heavy soils are valuable, in that they keep the water stored up beyond the limits of excessive evaporation. This, however, is only for a short period. During a prolonged hot season the water is brought up to the surface continually by capillary action,and these soils become intensely dry to a very great depth.

The food capacity of the soil is the second great factor in relation to plant growth. All plants require from their soils certain chemical foods in order to grow successfully. Some soils are very rich in these foods, others are very deficient. Again, some plants require foods which other plants do not, hence it is important to know the chemical composition of the soil in order to understand the plants grown on it. This chemical composition depends on many factors. Much depends on the chemical composition of the rock underlying it, from which the soil is in most cases derived. Climatic factors may considerably modify this chemical composition ; vegetation again is a big factor in adding to the chemicals in a soil, particularly to its nitrogenous content.

Thirdly,must be considered the position of the soil, for on this depends its depth, maturity and drainage. Soils in valleys and on level plains have been able to accumulate to a much greater depth, and to attain a more mature state,than soils on sloping ground which are constantly subject to erosion and redeposition, hence the former are of much greater fertility.

Drainage is dependent either on the slope of the ground, or on the nature of the subsoil. Too great a slope means scouring under heavy rain and the soil cannot attain to any maturity ; too flat a surface with no drainage might cause a water-logged condition fatal to plant growth. Where the land is flat, as in many parts of the black soil regions of the Deccan, and where there is no topographical drainage, much depends on the nature of the subsoil. Sometimes this is a porous limestone layer termed " murum," which affords good drainage, and is particularly valuable in that the regur soils are heavy and might very easily become water-logged.

In view of these facts underlying soil productivity, the relative qualities of the Deccan soils may now be discussed, together with their distribution and some attempt at explaining their origin, which is in most cases, however, much in dispute. The only soil map for India which has been available, is

practically identical with the geological map, and is, therefore, based on the assumption that soils are the product of the rocks underlying them. Such a map conveys no real idea of the main asset of a soil—its degree of productivity ; hence, since this work is to treat of soils in their relation to production, the classification and soil map is based not only on factors of geology, but also on climate, topography, and vegetation, thus assuming that " soils are not merely the disintegrated product of the rocks underlying them, but rather are due to factors of climate, vegetation and topography acting on the weathered product."[1]

SOIL CLASSIFICATION OF THE DECCAN.

	Type	*Class.*	*Soil.*	*Example.*
Black soils or Regur.	A	I.	Deep black heavy.	Tapti valley (Bombay Pres.)
	A.	II.	Medium black heavy.	East Bombay Deccan.
	A.	III.	Poor black or sandy red.	Rugged trap uplands of Bombay Deccan.
Red loams.	B.	I.	Deep dark brown, or red and yellow loams.	Wainganga valley (C. Provinces).
	B.	II.	Medium red loams.	Mysore plateau.
	B.	III.	Poor sandy or gravelly red soils.	Rugged hills of Mysore plateau.
	C.		Dry porous laterite soils.	Capping many of Deccan hills.[2]
	D.		Lateritic, or ferruginous red, loamy, forest soils.	Coffee soils of Mysore.
	E.		Mixed gravelly, clay, or sandy soils.	Lower Godaveri and Kistna valleys.

The soils of type A are the typical regur or black cotton soils of the Deccan. The three classes represent grades of productivity ; the deep black soils are of very great fertility, the medium black of moderate fertility, and the poor black or sandy red of very low fertility.

The deep black soil represents regur at its greatest maturity ; it is typically the soil of the river valleys, or the more level plains of the black soil regions. It has its greatest extension on the trap of the plateau, along the valleys of the Tapti and Purna rivers, through the central valley or Payanghat of Berar, to the Wharda valley and the plain of Nagpur. It reaches its

1 Shantz and Marbut " Soils of Africa," 1923.
2 No exact data for distribution of these soils.

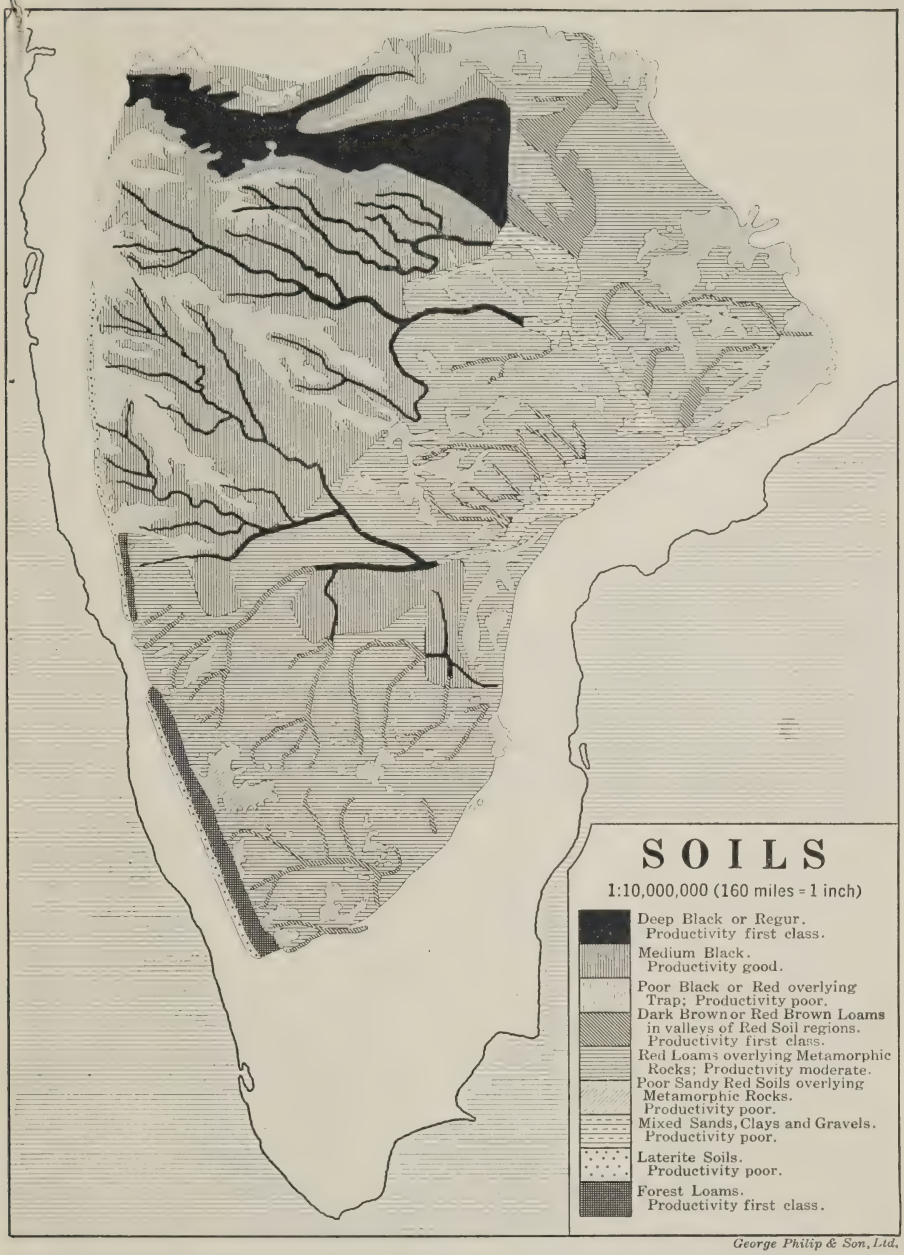


FIG. 2.

(This map shows the area discussed in the study).

greatest depth along the river valleys where it may be as deep as 20 feet. This great belt is the principal cotton, jowar, wheat and linseed land of the Deccan. Less extensive deposits are found in the valleys of all the rivers flowing through the black soil regions, as the Godaveri, Penganga, Bhima, or Kistna, and in many cases these soils have been carried down by the rivers well beyond the limits of the regur zone.

Deposits of this soil are found in the valleys of many rivers of the plateau nowhere near the main regur tract; in the Nandyal valley of Madras, and the Cauvery valley of Southern Madras. They are alluvial deposits in these river valleys, but are not different from the black soils of the main regur tracts.

The medium black regur is the most widely distributed soil of the trap regions of the peninsula. It is a mature soil, but shallower than the first type, and it is found on the level or sloping trap lands of the Bombay Deccan and Karnatak. East of the Ghats, its continuity is broken by rugged east-west spurs of the Ghats, with lighter sandier red soils. It covers also the Nizam's dominions west of the Manjra river, exclusive of the rugged tracts of the Central Hyderabad range, where again red sandy soils are found. In Berar and the Western Central Provinces it covers the more rolling country the north and south of the central valley. A big extension of regur also occurs in the Madras Deccan in Eastern Bellary, Northern Anantapur, Western Kurnool, and Cuddapah, also in parts of Western Dharwar (Bombay Pres.) and Northern Chitaldrug (Mysore) ; in these latter regions it overlies not trap, but metamorphic rocks.

The poor black and red sandy soils, which form the third grade of regur are found throughout the trap regions on the rugged hills, where topographical conditions prevent maturity. They are essentially immature soils. They occur extensively along the eastern slopes of the Western Ghats within the trap area, and on the Satpuras ; they also occur on the east-west spurs of the Ghats, the Ajanta range, the Hyderabad range, and other minor spurs. The red sandy soils are the most typical of all these regions, and the fact that they, like most of the regur, overlie trap, has raised some difficult problems in relation to the origin of regur, further complicated by the fact that extensive deposits of regur are found overlying not trap, but metamorphic rocks.

The fact that regur has its greatest and most consistent distribution on the trap lands, and further, that, except in the river valleys of the region, the boundary of the trap is the boundary of the regur, would suggest that regur is due to subaerial weathering of trap, and such has been the view held till quite recently. It was further supported by the fact, that the only part of Bengal where regur occurred was the basaltic Rajmahal Range. It was definitely negatived however, by the discovery that the extensive tracts of black cotton soil outside the trap regions, particularly in Madras, were essentially similar to those overlying the trap, and yet there was no evidence in these regions of a former extension of trap ; the deposits occur either overlying metamorphic rocks as in Bellary, or as alluvial deposits in rivers of the metamorphic regions. The fact that the boundary of the trap was also the boundary of the regur, was attributed to the sudden change from a clay to a sandy soil,[1] and the occurrence of red soils within the trap regions, was proved to be due to the normal weathering of basalt.[2] The conclusion drawn, therefore, is that regur is a superficial formation, due to subaerial weathering of either trap or metamorphic rock, and a reason other than a purely geological one must be sought to explain its origin.

Such factors are to be looked for in the physical conditions found in association with regur, climate, topography and vegetation. The climatic factors in association show that regur is confined to those regions of the plateau with a high temperature and a rainfall not exceeding

1 Oldham "Manual of Geology of India."
2 Oldham "Manual of Geology of India."

50 ins. Its main distribution is in those regions with a rainfall 20-40 ins. Above this rainfall, as shown on the slopes of the Western Ghats, the greater supply of moisture tends to remove the silicates and laterite is formed; regur contains a high proportion of silicates, hence its absence from regions of very high rainfall.

A second physical feature associated with regur is, that everywhere, it occurs only on level or gently sloping surfaces, save in the river valleys where it is alluvial. Thus it is a mature soil which has attained its characteristics in situ. This fact is particularly interesting, in that, where on the trap the land becomes rugged, prohibiting soil maturity, regur gives way to the red sandy soils, which, being constantly rejuvenated, are immature soils. Since the best regur soils are found on the levels, and become poorer on sloping surfaces, till finally on the rugged lands they are replaced by the red soils, it would seem to suggest that the first class regur is the most mature soil, the medium regur not quite so mature, and the red soils, stages on the way to regur formation, but such that will never attain to a mature form as they are too often rejuvenated.

Regur is the most valuable agriculturally of all the Deccan soils, and " in spite of the fact that it occurs in close relationship with many geological formations, and varies in colour and working properties, it possesses many common characteristics."[1] It is a highly argillaceous soil, with resultant high retentivity, and it is this fact which gives to it its particular value on the Deccan, since it can retain that most precious requirement of agriculture in the region, water, which over most of the plateau, occurs at one season only. Such is the retentive capacity of this soil, that it can conserve sufficient moisture from the " kharif " or summer rains period, to bring a " rabi " or winter crop to maturity in February or March. It is further valuable, in view of the erratic character of the rains within the rainy season. Long draught and sudden down-pours are common, and regur, being retentive, can conserve rainfall from a heavy downpour for use in a dry period. Its clayey character does not prevent it from being workable after the rains, save in particular cases. This fact is probably due to its high calcareous content, and in some parts to the drainage afforded by the murum beneath it. In the Tapti valley, however, where the soils are particularly heavy, and where the underlying material is impervious yellow clay, the soil often becomes quite incapable of cultivation till the rains are over; it is typically " rabi " land. During the hot dry season, regur, being a clay soil, becomes baked hard, and huge cracks are formed on the surface, which extend some distance down. At this period it is quite incapable of cultivation—even trees will not exist, since the cracking tears their roots apart.[2] The cracking, however, is one of the most valuable attributes which the soil possesses. The surface soil, owing to exposure, becomes crumbled, and is carried either by the winds or by the first rain falls, into the cracks, whence it falls some distance beneath the surface. This is one of the greatest factors in the fertility of regur. Its value lies in the constant process of reversal which takes place—the surface soil being continually carried down the cracks,and the lower soil layers being brought to the surface. This not only prevents the surface layers of the soil from being exhausted, (which are the most important for plant growth), but permits of thorough aeration. To these facts, together with its great retentivity, must be attributed its fertility.

In view of this great fertility the chemical composition of regur is somewhat surprising; all regur soils are strikingly deficient in nitrogen, which

1 Harrison and Sivan, Department Agriculture India, Chemical Series, Bull. No. 5.
2 The absence of trees on the Deccan regur lands may be due to this fact.

ranges between ·012 and ·05 per cent. This is due to the absence of organic matter in the soil; regur has only a scant vegetation. But for this fact one might be tempted to class these soils along with the chernozem black soils of Russia. When it is remembered that nitrogen is the most vital requirement of any soil for the plant, in that it renders most of the other constituents of the soil available for plant use, the enormous value of the soil reversal and retentivity, as compensating factors for this deficiency, can be appreciated. Of the other plant requirements, lime is present in sufficiency, and its presence physically aids the friability of the soil, save when it occurs too frequently as nodules of kunkar. Regur contains sufficient magnesia and potash for plant requirements, but is somewhat deficient in phosphoric acid. It contains high percentages of both oxide of iron and alumina.

Difficulty has been encountered in explaining the colour of regur. The black colour of a soil is usually attributable to humus, but this cannot be said of regur. Annet, from a study of the regur soils of the trap, concluded that the colour was due to the presence of a black mineral, titaniferous magnetite.[1] Regur soils from the trap and from South Madras have also been analysed by Harrison and Sivan, who assert that the black colour is due to the presence of dark particles of low specific gravity, common to all regur soils, assisted by the low percentage of organic matter.[2] The Madras regur differs from the Trap regur, in that it lacks the black mineral present in the latter.

The agricultural properties of the red soils found on the trap, in association with regur, are quite different from those of regur. They are typically poor sandy upland soils, coarse in texture, and unretentive. This latter fact makes them useless in the " rabi " season and they are typically " kharif "[3] cropped soils—the crop being generally inferior millet or pulse. They are best in a season of light and frequent rains, since a heavy fall runs off the surface, scouring the soil as it goes. In the valleys they are generally replaced by regur soils. Of their composition no information is available.

Class B. Red Soils.

These soils are typically those overlying the metamorphic rocks of the Southern and Eastern Deccan, outside the trap area. They are generally ascribed as due to the weathering of the metamorphic rocks, and are described by Leather as " sandy clays, coloured red by iron peroxide."[4] The three classes into which these soils are divided are based on their productive capacity. The richest and deepest of the highest productivity, are found in the river valleys throughout the region, where they have either been carried down by the river or washed down the valley slopes. The most fertile stretch of these soils is in the Wainganga valley of the Eastern Central Provinces, where they are either rich dark brown or red or yellow loams; but they occur throughout the river valleys of the metamorphic regions.

The second class red loams have the widest distribution, occurring on the sloping hill-sides and more level reaches of the metamorphic regions, while the third class, the least mature soil of all, scanty, stony,and infertile, is found on the steep and rugged uplands throughout Mysore, Southern Bombay, Eastern Madras, and Eastern Central Provinces. These latter seem essentially similar to the red soils of the trap regions in their productive capacity, being extremely poor, and of little use agriculturally. Since no data are available for either, however, no definite statement as to their relationship can be made.

1 Annet. Bull. No. 9, Memoirs Department Agriculture India, Chemical Series.
2 Harrison & Sivan Bull. No. 5, Memoirs Department Agriculture India, Chemical Series.
3 " Kharif " refers to the rainy season crop and " rabi " to the cool season crop.
4 Leather. " Report to Government of India on Soils," 1897.

In physical composition these red loams differ absolutely from regur. They are primarily sandy and not clayey soils, i.e., they are of coarser texture and far less retentive, and are only at their best agriculturally when they can be supplied frequently with water, either from rainfall or from irrigation. They are typically, therefore, either " dry "[1] kharif lands or " wet "[2] rabi or hot season lands. They are the typical rice lands of the Deccan, as the regur soils are the typical cotton and millet lands. The richest of the red and brown loams in the valleys are of very high productive value, and when irrigated and manured will yield two or three crops a year. The medium soils require greater cultivation, but are productive if well manured ; the poor red soils are not worth either manuring or irrigating and grow only " dry " crops of inferior millets. Irrigation is essential over most of the red loam lands, since being non-retentive, they cannot produce more than one crop a year without it, and further, under the erratic rainfall conditions of the plateau, irrigation must be available to supplement breaks in the rains, when the red loams are quickly robbed of all their water by the hot sun. Only in the river valleys, of which the Wainganga is the best, are these soils used for rabi crops without irrigation. Thus it is that the red loam lands, in contra-distinction to regur, are typically irrigated soils.[3] Chemically these soils are poorer than regur, and require, save in the river valleys, good manuring if they are to yield well. The percentage of humus, phosphoric acid and lime in them is low, and they do not redeem these deficiencies as regur does, by retentivity or soil reversal. Their agricultural value then, mainly lies in the extent of their irrigation or manuring. Very little information beyond this is available about them.

Classes C. & D.—Laterite Soils.

C.—These soils overlie the lateritic formations of the plateau. Both the definition of laterite and the theories as to its origin vary considerably. The formation is found in many parts of the tropics, and in association with many geological formations, thus proving,as does regur,that soil type is due to many physical factors operating on the weathered product of the rock. Laterite in its most typical form is a porous, argillaceous rock,which is coloured red by the large amount of iron peroxide present,and from which the silica has been removed by the action of chemicals dissolved in water. The soils, being very porous, tend to be dry and hungry, and are frequently found on the tops of the trap hills of the Deccan ; when manured and irrigated they are productive garden land.

D.—The forest soils, of which the coffee soils of Mysore are typical, are those which occur on the slopes of the Western Ghats and have been enriched with forest humus. These soils may be either red and brown loams, or lateritic soils which have been brought down from the laterite cappings on the crests of the Ghats, and the mixture of these lighter soils with the rich forest humus, gives a very fertile and easily worked loam. The laterite soils of the plateau are often confused with the red soils, being very similar to them in chemical composition. Like both regur and the red loams they contain a very low amount of nitrogen ; they contain also a low amount of phosphoric acid as do the red loams. Very little lime is present, and this fact is most noticeable in the coffee districts where lime must be supplied artificially. The amount of ferric oxide and alumina in laterite is high, and it is their red colour due to the ferric oxide which makes them look like the red loams. In their physical properties the two soils are similar, both being unretentive and requiring watering to make them productive. In spite of these similarities, however,

1-2 " Dry " and " Wet " refer to unirrigated and irrigated land respectively.
3 See Section on Irrigation.

Dr. Mann states that the laterite soils are quite distinct from the red soils, being very deep, while the red soils are much shallower and often stony. Since very little information is forthcoming about the red soils either of the trap region or of the metamorphic region, no further comparisons can be made.

Studying the distribution of laterite on the Deccan, however, it is at once apparent that the physical factors of climate and topography, found in association with laterite, are not those found in association with the red soils; on these grounds they must be differentiated from them.

It has already been stated that laterite is found overlying rocks of widely different types, gneiss, trap, and granite, and Fox states that all rocks are potential sources of laterite provided they are not of impossible chemical composition.[1] A second feature of their distribution is that throughout the world they are in *process of formation* only in regions of hot moist climates, with a rainfall over 50 inches. This differentiates them again from the red loams. A third factor in association is, that everywhere they are found only on level or gently sloping surfaces, and hence are matured soils. The red loams are found on more sloping or rugged lands, and are more immature.

The distribution of laterite in India is confined to the Peninsula, mainly south of the latitude of Poona. North of this it occurs only as isolated cappings. South of this it caps the crests of the Western Ghats, at altitudes of 2,000 to 5,000 feet, and its distribution follows the regions of high temperature, and a rainfall not less than 50 inches. The low level laterite often found on the plains below the crests, is only reconsolidated high level laterite. Ferruginous red loams, very like the laterites, have been found on the Nilgiris at elevations of 6,000 feet or so, but these are not generally accepted as laterites, though very similar to them; it is possible that they are stages on the way to lateritic formation. Tracts of laterite are found throughout the plateau, capping the flat-topped hills, as near Bidar and Sholapur, but here the laterite is not in process of formation, it is a relic of past ages, when different climatic conditions prevailed from those of the present.

In their recent work on the "Soils of Africa," Shantz and Marbut have mapped the red loam soils of Africa in belts around the laterites. The distribution of these soils shows that they are found in those regions where the land is not sufficiently level for laterite formation, or where the rainfall is not heavy enough. This distribution finds a parallel in India where the red loams occur on lands not level enough for laterite formation, or districts where the rainfall is not heavy enough. This leads then, to the conclusion that the red loams are stages on the way to laterite formation, but will never attain to it, as topographical and climatic factors are operating against them. It is questionable whether such a theory could not be applied to all the soil types of the Deccan. It seems feasible to suggest, that, in those level regions with a rainfall under 50 inches and a hot climate, the normal mature soil formation is regur; in the level regions with a hot climate and a rainfall over 50 inches the mature soil formation is laterite. In the intermediate zone where the land is more sloping and rugged, and the rainfall either more or less than 50 inches the soil is an immature red loam, which increases in immaturity in proportion to the ruggedness of the land. This red loam, because of its instability, attains neither to lateritic nor to regur formation, and may be regarded as a stage between the two. An ideal sequence then, is a high level laterite capping, red loam on the slope increasing in maturity as the land becomes more level, till at the foot on the level land it is replaced by mature regur soil.

1 Memoirs Geological Survey India, 1923.

Alluvial Soils.

Little need be said about these soils. In the valleys of the regur regions they are deep regur, while in the river valleys of the red loam regions, they are deep red loams. The soils of the lower courses of the Kistna and Godaveri, (on the plateau) are in some ways different. These rivers in their lower courses flow over geological formations, yielding a very sandy and gravelly weathered product, the Cuddapah series in the former river, and the Gondwana series in the latter. In parts the soils are fertile mixed loams, but in others, stretches of poor sandy soils or gravels occur, which are of very low productivity.

The above survey of Deccan soils is only a very general one; the soils vary enormously within each of these regions, and generally the cultivator has his own name for all the varieties of soil which occur on his land. But in spite of these varieties, practically all of the Deccan soils can be included under one of the soil types enumerated.

III.—RAINFALL OF THE DECCAN.

Climatically the Indian peninsula is part of the great monsoon area of Asia, and exhibits the monsoonal control in a more perfect form than any other part of this area. The term "monsoon" technically applies to the reversal of winds which takes place throughout the monsoon area, and which divides the climatic year into two distinct periods—that of the south west Monsoon, and that of the north-east Monsoon. "Monsoon," however, to the Indian cultivator, means but one thing, rain, since 85 per cent. of India's rainfall is brought with the south west monsoon. Perhaps in no other region of the world does the climatic regime enter so much into every aspect of life as in the Indian peninsula, this from the fact that life here is based on agriculture, which is dependent for its very existence on the rainfall, in its turn almost wholly dependent on the south west Monsoon. Thus the south west Monsoon is the pivot upon which almost the whole of Indian life swings. Any variation in this pivot, however slight, means a consequent variation throughout the whole structure of life in the region. The rainfall of India thus has definite periodicity due to monsoonal control, and for this reason the climatic year may be divided as follows:

A. Season of the south west Monsoon.[1]
   1. Mid June to Mid September, season of general rains.
   2. Mid September to December, season of retreating Monsoon.

B. Season of north east Monsoon.
   1. January and February, cold weather season.
   2. March to Mid June, hot weather season.

The climatic regime throughout India is as above, but the amount and distribution of the rainfall is far from uniform.

From a study of the rainfall statistics of the Indian Meteorological Department,[2] it is apparent that there is a distinct regional distribution of rainfall regimes on the Deccan plateau. Fig. 3 shows the distribution of these rainfall regimes. It has been constructed upon an analysis of rainfall graphs, plotted from the figures of the Indian Meteorological Department.

1 "Climates of the Continents." Kendrew.
2 Monthly and Annual Normals of Rainfall. Memoirs Indian Meteorological Society, 1913. Vol. 22, Pt. I.

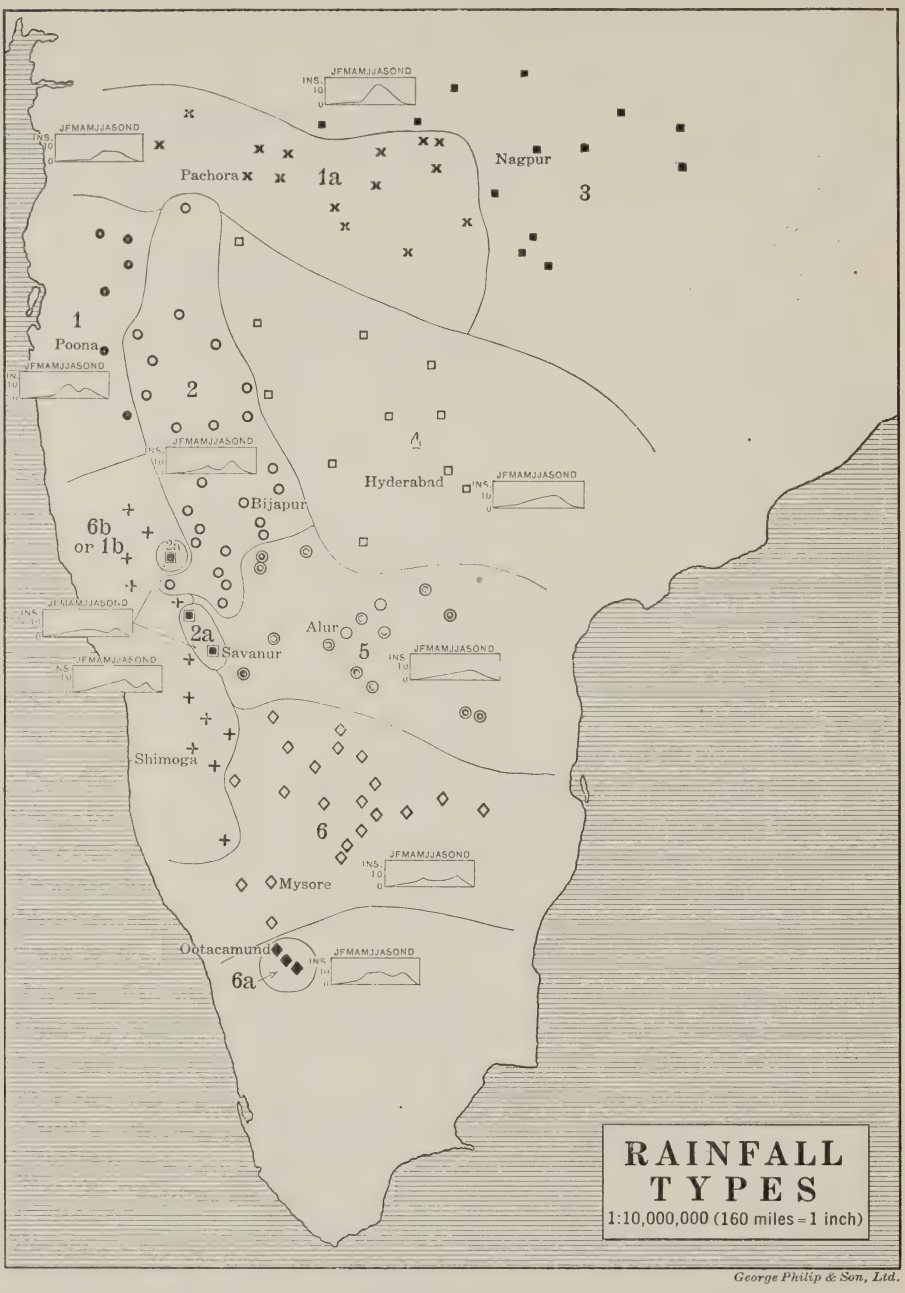


FIG. 3.

It will be seen that the Deccan resolves itself into six main rainfall regions which may first be enumerated :

1.—The region comprising the leeward slopes of the Western Ghats, from the Satpuras, south to the Mysore plateau, and as far east as a line 50-60 miles east of Poona. A sub region of this type is found in the Tapti valley, in East and West Khandesh and Berar.

2.—The region comprising the Eastern Bombay Deccan, from south of the Tapti river to the edge of the Mysore plateau.

3.—The region comprising the basins of the Wharda, Wainganga, and Lower Penganga Rivers, tributaries of the Godaveri, and the Lower Godaveri valley.

4.—The region comprising Central and Eastern Hyderabad.

5.—The region comprising the Madras Deccan, and south western Hyderabad.

6.—The plateau of Mysore, with sub regions on the Western Ghat slopes, and on the Nilgiris.

Region 1.

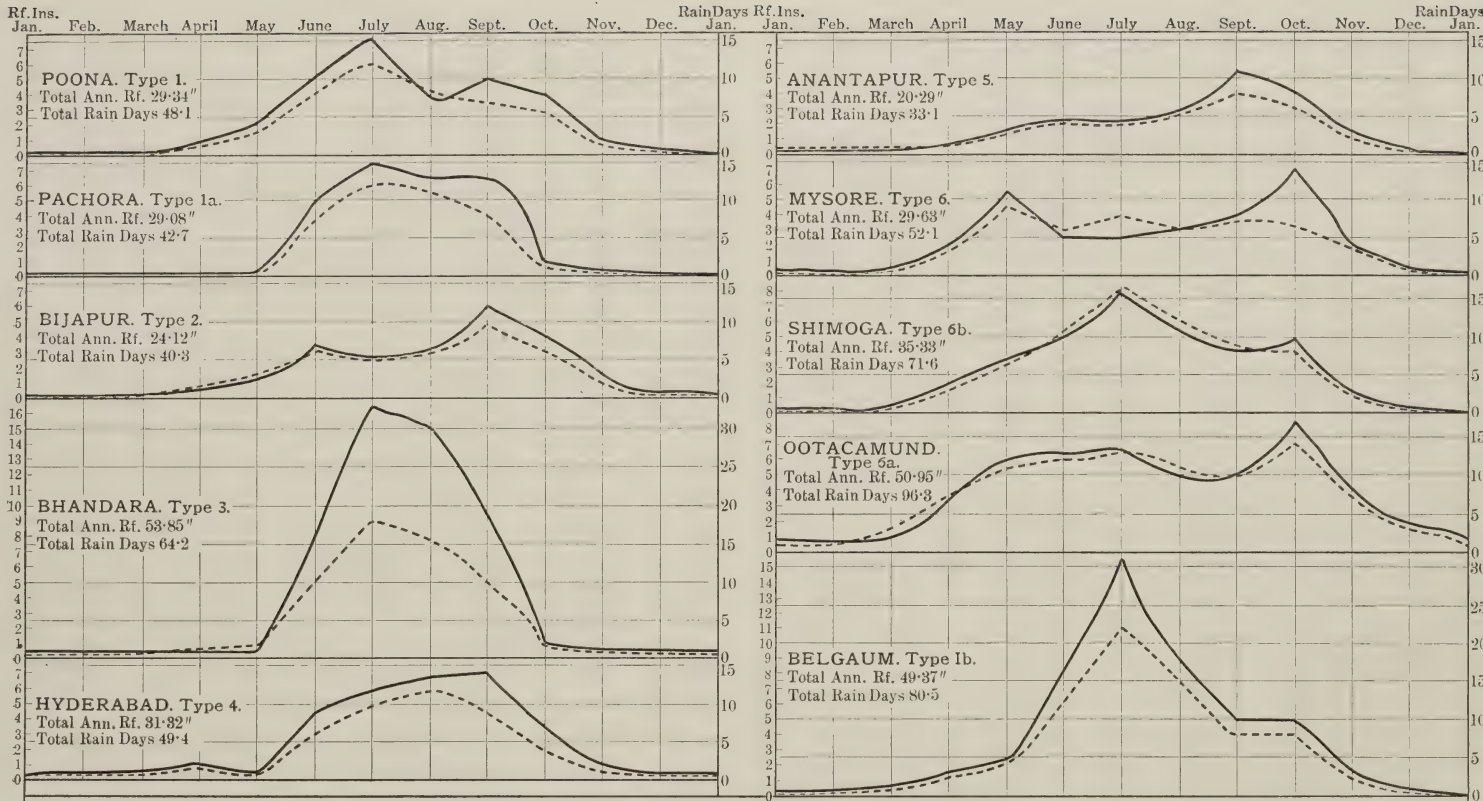
This region extends north and south along the leeward slopes of the Western Ghats, but is not sufficiently far away from the crest to be in the rain shadow, hence it has a much higher and more certain rainfall than the regions further east which are lower in altitude and very definitely in the rain shadow. The graphs plotted for this region, of which Poona may be taken as typical, show that the region as far south as Belgaum has rain from June to October, while south of this it has appreciable rains in May also, but with its main rainy season June to October. The dominant rainfall features of this region are, a major maximum in July, a slight drop in August, and a rise again to a minor maximum in September. From Kohalpur southwards the minor maximum occurs in October. The total rainfall is about 30 ins., of which 6in.-10ins. falls in July while 5ins. or less falls in September. A feature of this Western region South of Belgaum, is the May rainfall generally 2ins.-3ins., which is absent in the more northerly parts.

The region is practically rainless from the end of October till June in the North, and May in the South, having the cold season November, December, January and February, and the hot season March to May or June.

The sub-region of this type (1A) in the Khandesh valley and Berar valley, of which Pachora is typical, seems to be a distinctly transitional type between that of Poona with its major maximum in July and minor maximum in September, and the Godaveri valley type with its single maximum in July. It differs from the former in that it has no September maximum, and from the latter in that its July rainfall is considerably less. Although the September maximum is absent in this region, the graph shows that the rainfall for that month is no less here than in the Poona region; in fact it increases eastwards. The variation in the graph is due to the fact that in the region of which Poona is typical there is a distinct drop in August, while the Pachora type has no such drop.

Region 2.

This comprises the East Bombay Deccan as far west as a line lying 50 or 60 miles to the east of Poona, and extending from south of the Tapti valley in the north to the rim of the Mysore plateau in the south; it may be termed the Ghat rain shadow type. The graphs for Bijapur and Mudhol are typical. They show, as does that of Poona, two maxima of rainfall, but differ from the latter in that the minor maximum of the year comes at the beginning of the rainy season in June, and the major maximum towards the end of the season in September, or, at some stations in the south, in October. These East Deccan stations exhibit the same features in their spring rainfall as do the stations of Region 1., i.e., the southern stations show a May rainfall while the northern stations do not.



GRAPHS SHOWING ANNUAL RAINFALL REGIMES FOR TYPICAL DECCAN STATIONS.

The total annual rainfall is low, as might be anticipated from a rain shadow area. It ranges from 20ins. to 30ins., and the region is one of the most precarious rainfall tracts of the whole of the Deccan. Failure of rains has caused enormous ravages through famine from time to time.

Region 3.

This is characteristic of the valleys of the Lower Godaveri, Wharda, Lower Penganga and Wainganga, and the hill stations of the Satpura and Mahadeo hills. The graph is characterised by a very rapid rise from June to a high maximum in July ; from this month there is a progressive decrease with appreciable rains till the end of October. Bhandara is typical of this region. The most remarkable feature about this regime is the extremely high July rainfall which in some cases, as at Chanda, is over 15ins., while in Region 1 it is only 6ins. to 10ins. in this month.

From the July maximum the rainfall decreases, showing no secondary maximum as the Poona type does, and yet the September rainfall is higher than for the Poona type ; the latter is about 5ins., while in the Godaveri type it attains 8ins.-10ins. at some stations. That this September rainfall is not a secondary maximum is due to the fact that there is no August decrease. A feature of the eastern part of this region is the occurrence of storms in January, February and early March, often accompanied by hail, and very detrimental to the spring crops.

The rainfall throughout this region is the most certain on the Deccan. It was once supposed to be a region where the monsoon never failed, but this has been disproved by the failure of rains in 1896-7, and 1899-1900. This however, was the first time they had been known to do so and the region is definitely one of very assured rains.[1]

Region 4.

This comprises the highland country of central, eastern and southern Hyderabad, and the graph may be termed the Hyderabad type. It gives way to the type just discussed on the north, to the rain shadow type on the west, and to the Madras type on the south, and appears to grade off into these types at its limits. It possesses a distinctive type of its own in that it has very considerable rainfall from July to September, the latter month showing a slight maximum. The rainfall is certain as compared with the region to the west, and is generally sufficient for agriculture, ranging as it does from 30ins. to 40ins.

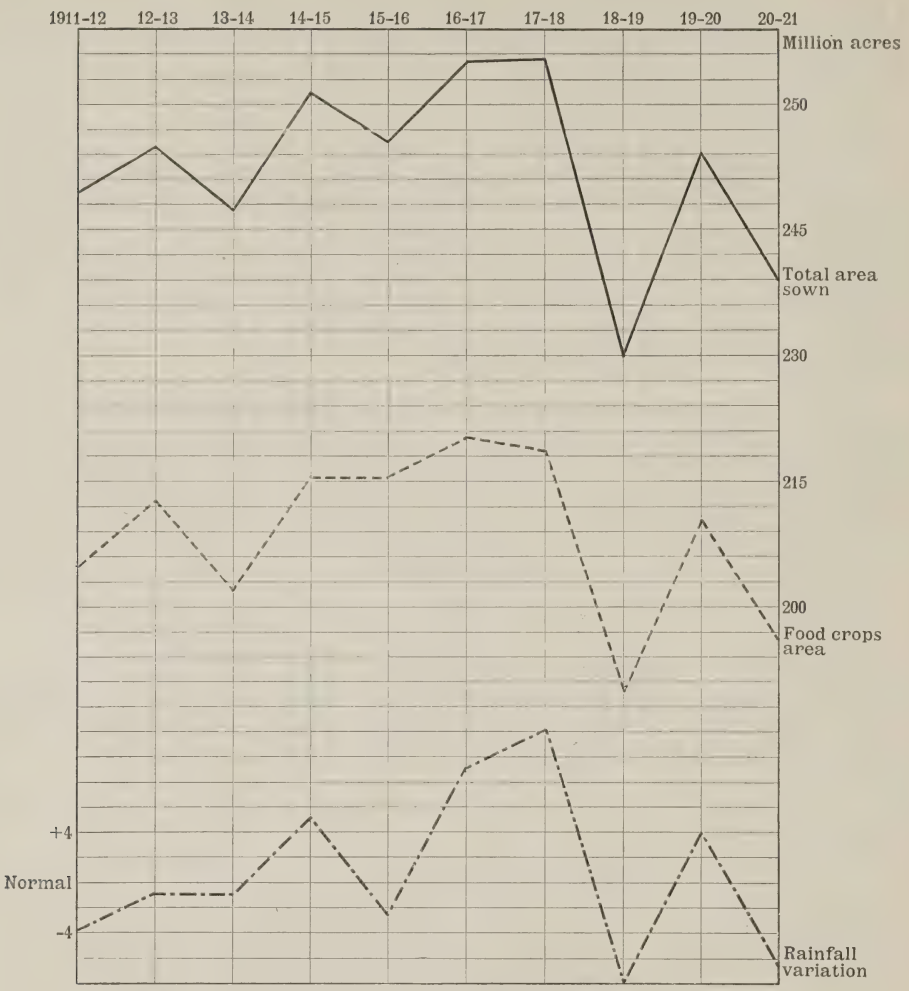
Region 5.

This region comprises the Madras Deccan and south western Hyderabad, and is the region of scantiest and most precarious rainfall on the plateau, due to the fact that it gets the full benefit of neither the south west monsoon proper nor the south west monsoon in retreat. The graphs show that the region has an extremely low early summer rainfall (Anantapur is typical), which rises gradually from May to a maximum in September and October, with appreciable rains till mid-November. The June maximum tends to appear in the west where it grades into the east Bombay Deccan type.

Region 6.

This region comprises the Mysore plateau and the Nilgiris, and exhibits very different characters from the regions previously discussed. The graphs

1 Report Indian Irrigation Commission, 1901-03,



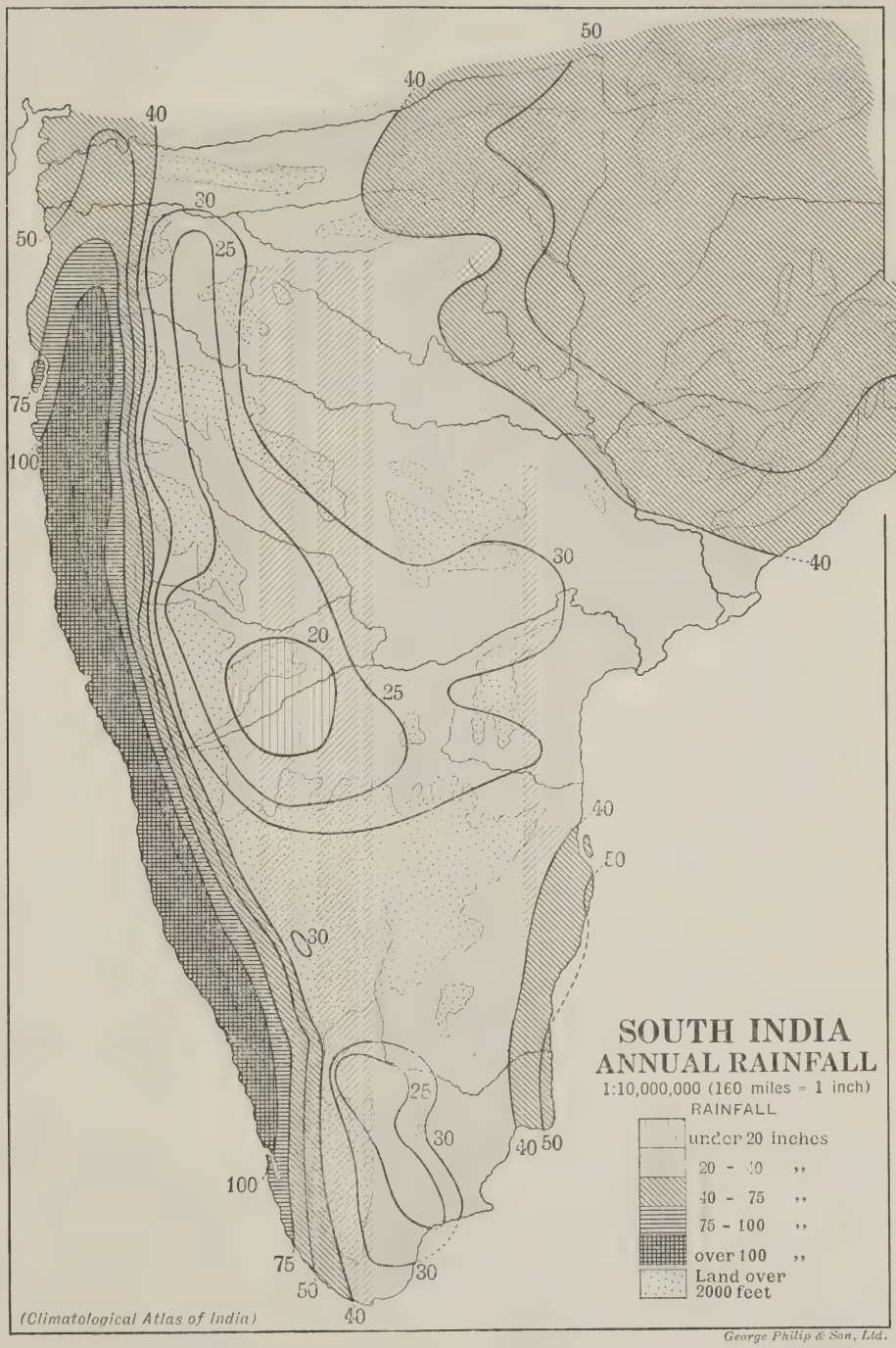
Graphs showing relationship between rainfall variation and area cropped.

FIG. 5.

are all very similar to each other and Mysore or Bangalore may be taken as typical. All show that there is little or no rainfall in January and February, but from March there is an increase to a maximum of about 5ins. in May. These spring rains are known in Mysore as mango showers, but are most important agriculturally in the coffee districts where they are known as "blossom showers." It is on this rainfall that the coffee flowering is dependent.

From this May maximum there is a drop during June, July and August, but there is a rise again to the major maximum of the year in October. All the graphs show appreciable rains to the end of November.

It can be seen from the graphs that this region is more favoured in its rainfall distribution than any other part of the plateau in that it has rain during three seasons. This factor is a very vital one in discussing Indian rainfall, since it is not so much the amount that falls which is the vital fact in agriculture, but the period over which it extends.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SOUTH INDIA
ANNUAL RAINFALL
1:10,000,000 (160 miles = 1 inch)
RAINFALL
under 20 inches
20 - 40 ,,
40 - 75 ,,
75 - 100 ,,
over 100 ,,
Land over 2000 feet
(Climatological Atlas of India)
George Philip & Son, Ltd.

FIG. 6.

A sub type of this Mysore regîme (6A) is found in the Nilgiris.

The three graphs drawn for the region show that they have, like the Mysore type, a May and October maximum, but they also show a small maximum in July. The region further has light rains in January and February. A further variation of the Mysore type (6B) is apparent in those stations on the leeward side of the Western Ghats a little to the east of the crest. Shimoga is typical of this ; it shows a major maximum in July, as in similarly placed stations further north, and a secondary maximum in October.

Character of Indian Rainfall.

The character of the rainfalls in India is one of the main factors in relation to agriculture. As we have already seen, it is not so much the amount of rain which falls which is the vital factor, but the nature and distribution of the falls. It is said in India that " it never rains but it pours " and this is literally true. It is well shown by the graphs of the number of rain days per month. These have been plotted over the rainfall graphs, (Fig. 4), to ascertain the relationship between the period and amount of the rain falling, and the character of the falls. It is apparent from the graphs,that the falls are remarkably heavy throughout, a fall of ½in. per day seems to be quite an ordinary occurrence, and the falls are often as high as 1in. per day. A study of these rain day graphs[1] in relation to the regional rainfall graphs, brings out an interesting feature—that the late rains of September and October are associated with much heavier falls per day (over 1in. in some cases) than in July and August when the monsoon is at its height—the falls here being about ½in. per day. The distinction is well shown in the Eastern Bombay Deccan graphs.

It is noticeable also, that this region of the East Bombay Deccan, which it will be remembered has a June maximum of rainfall, shows heavier falls per day for June than for July. This is perhaps due to the opening of the monsoon with thunderstorms.

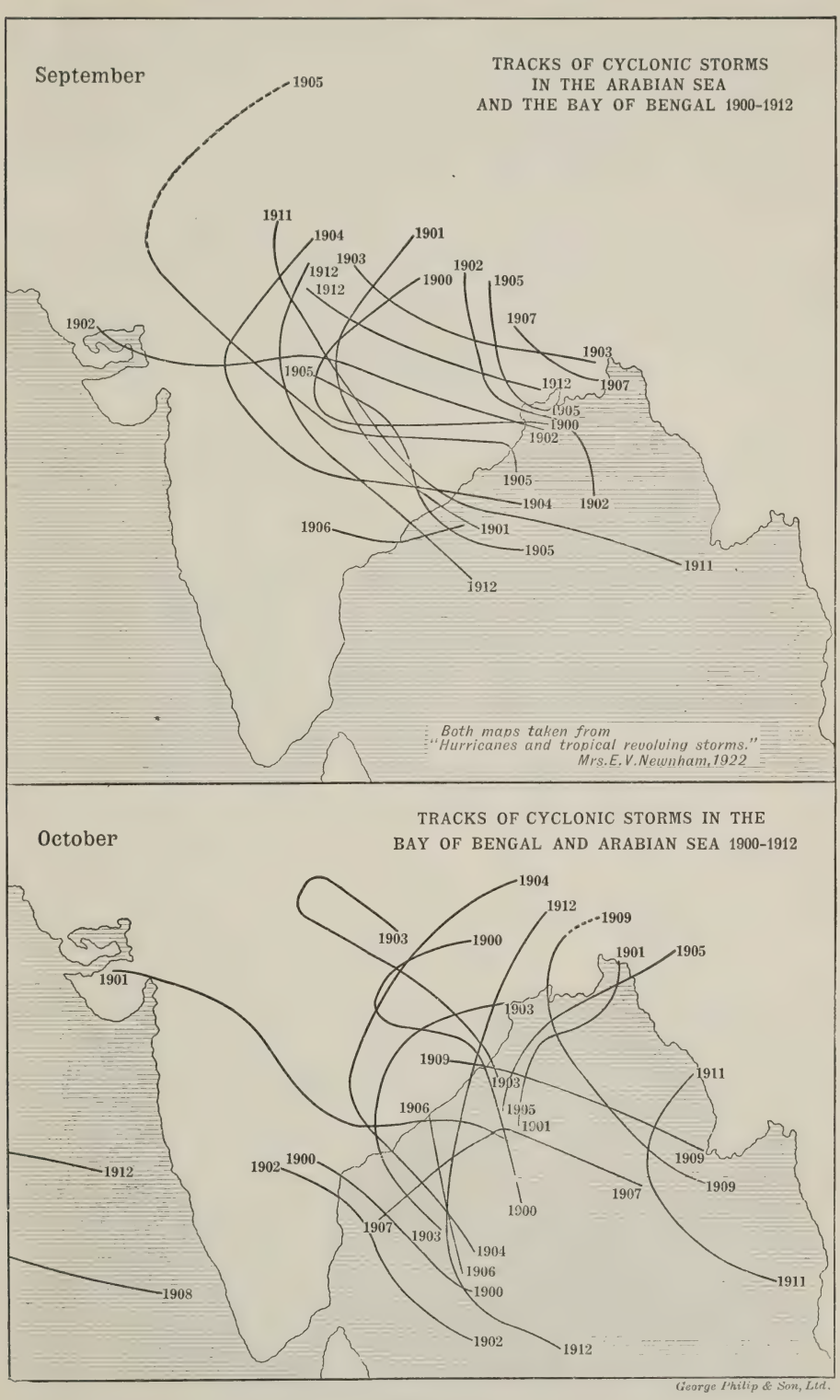
The heavy falls of the regions with an October maximum is definitely related to the cyclone tracks in the regions,from the Bay of Bengal, which are accompanied by very heavy rainfall. These cyclone tracks (Fig. 7) would also account for the very heavy September falls in the heavy and certain rainfall region of the Central Provinces.[2] It is usual in India to have a heavy fall and then a break ; the better distributed the rain, and the shorter the breaks the better it is for the cultivator, although the Deccan possesses a very valuable attribute in the extent of its " regur " soils, which, being retentive, can utilise a heavy shower by storing it for use during a long break.

In consequence, however, of the general character of the Indian rainfalls, they are not as valuable for their amount as they might be,—the following passage from Blandford[3] may be quoted :—" In consequence of the character of Indian rainfall it is less penetrating in proportion to quantity than in countries where much of it falls in a state of fine division, allowing time for its absorption by the ground ; instead of feeding perrennial springs, and nourishing an absorbant cushion of green herbage, the greater part of it flows off the surface and fills the dry beds of drains and watercourses with temporary

1 Monthly and Annual Normals of Rain Days. Memoirs Indian Meteorological Dept., Vol. 22, Pt. II, 1913.

2 " Newnham," Hurricanes and Tropical Revolving Storms," Meteorological Office, No. 19.

3 " The Climates and Weather of India, Ceylon and Burma." H. F. Blandford, 1889.


September
TRACKS OF CYCLONIC STORMS
IN THE ARABIAN SEA
AND THE BAY OF BENGAL 1900-1912
1905
1911
1904
1901
1903
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1905
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1902
1906
1901
1905
1911
1912
Both maps taken from
"Hurricanes and tropical revolving storms."
Mrs.E.V.Newnham,1922
October
TRACKS OF CYCLONIC STORMS IN THE
BAY OF BENGAL AND ARABIAN SEA 1900-1912
1904
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FIG. 7.

torrents. In uncultivated tracts where the jungle fires have destroyed the withered grass and bushy undergrowth, and have laid bare the soil and hardened its surface, the action is greatly enhanced, and while the perennial supplies which depend on the absorbed rain are either greatly reduced or altogether suppressed, a rainfall which if husbanded by nature and art would suffice for the agricultural and domestic requirements of the population, is thrown into the nullahs and rivers, and not only is wasted and lost for any useful purpose, but by the production of floods, becomes an agent of destruction."

Thus the two main steps to be taken by the Indian cultivator, in order to utilise the rainfall to its best advantage, must be, first, to protect the land during the heavy falls in order to prevent the scouring of the soil,and secondly, where soil does not perform this function, to conserve the excess from these heavy falls for breaks in the rain. This leads to a brief discussion of irrigation in relation to the soil and climatic factors of the region.

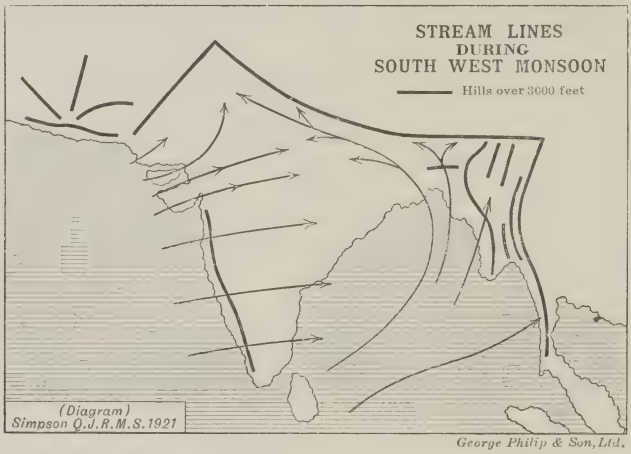


Fig. 8.

IV.—IRRIGATION IN RELATION TO SOIL AND CLIMATIC FACTORS.

Irrigation has a particular significance on the Deccan, in view of the rainfall conditions, which briefly can be summarised as a short one-season rainfall, within which season the rains are scanty and their distribution erratic. Irrigation is an attempt to stabilise rainfall conditions, either by supplying water at a season when rain does not fall, or by supplementing the rainfall in the rainy season when it is insufficient, or when a long break occurs. This study does not permit of a detailed survey of irrigation on the Deccan ; only a brief review is possible, and it will be based on an analysis of Fig. 9 constructed from the irrigation figures of the Agricultural Statistics of India 1920-21. The shading shows the percentage of cropped area irrigated in each district, and the colours denote the type of irrigation, well, tank or canal.

The first noticeable fact is, that the greatest intensity of irrigation is in the red loam regions of the plateau, the regur regions showing only a very slight percentage of irrigation. The first reason for this lies in the relative retentivity of the two soil types, and their response to irrigation. The red loam soils are not retentive, and they depend greatly upon irrigation to supplement

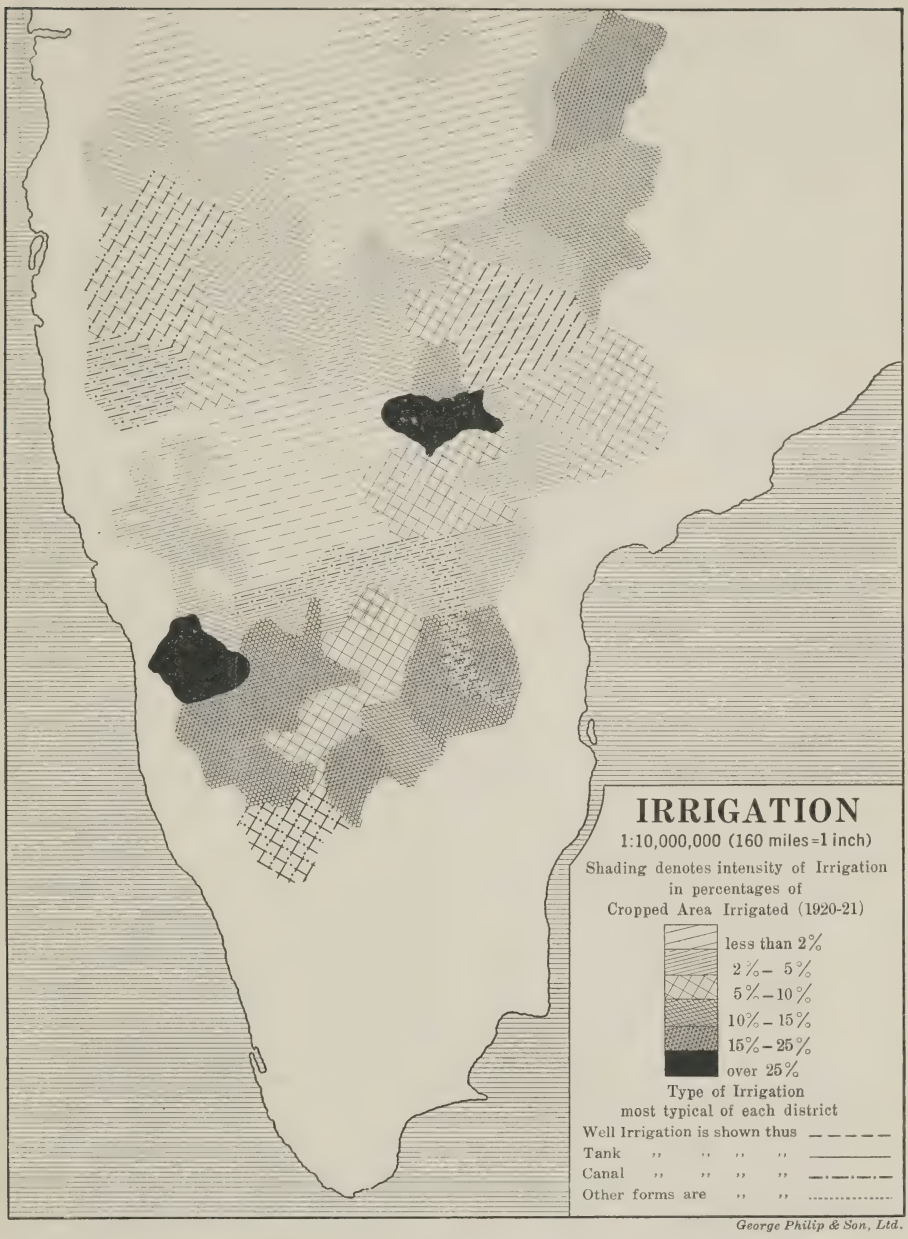


FIG. 9.

this lack of retentivity; otherwise they could be cropped only during the kharif season. The regur soils, being retentive, do not require irrigation so particularly. Further, irrigation gives far more successful results on the red soils than on the regur. The former, being light, do not become sodden when water is applied, and they drain freely and easily. Regur does not respond so well, and save where the murum layer is near the surface and allows of very free drainage, they tend to become sodden. The deeper varieties, where the murum is very deep or absent, are rarely irrigated successfully, but the shallower soils have responded quite well.

The second factor in determining the intensity of irrigation is rainfall. Irrigation on the Deccan is largely dependent on rainfall, and the fact that the red loam lands are for the most part regions of heavier and more certain rainfall than the regur lands, is an inducement to irrigation on them. The importance of the rainfall factor is apparent in the degree of intensity of irrigation within the red loam regions. It is high in western Mysore where the rainfall is heavy and assured, and also in the Wainganga valley of the Central Provinces, where again the rainfall is high and assured, while in the red soil regions of south western Hyderabad where the rainfall is scanty and uncertain, it is practically absent. The regur lands being mainly regions of low and uncertain rainfall are very little irrigated save along the western strip on the Ghat slopes (leeward), where rainfall is heavier and more certain, and the soils are lighter.

The methods of irrigation again reflect the geographical conditions of the regions. They may be divided into three main classes. " Under ' canals ' are classed all those works of any considerable size for diverting the waters of streams or rivers and carrying them on to the land ; under ' tanks ' all works for the storage of water, and all the natural depressions of which the water is used for irrigation, and under ' wells ' works giving access to the subterranean supply, or to the waters of rivers, which, running deep below the general level of the ground, have to be lifted vertically before they can be made to flow into the fields." [1]

Tanks or wells, both age-long native methods, are the most extensive irrigation works on the Deccan. The distribution map shows that the domain of tank irrigation is the metamorphic region ; it is practically absent from the regur region. This is due to topographical factors. Tank irrigation is carried out by blocking up a depression in the surface of the ground, or in a ravine, to hold up the water behind it. The topography required for this method is necessarily an uneven one, such as the granitic country supplies ; the regur lands, being fairly level, are quite unsuited. Also, tank irrigation requires a reliable rainfall, since the tank is dependent for its water supply on the rains ; this again would militate against its occurrence in the regur regions. The typical tank of the Deccan is generally small,irrigating only a few acres, and it is essentially a native undertaking,—practically every village of the granitic country has its tank. These village tanks are in striking contrast to the giant irrigation tanks along the Western parts of the Bombay Deccan and in parts of Mysore and Madras (Fig. 10) which are due to Government enterprise. These gigantic works irrigate hundreds of acres, and their extension in the future holds big possibilities for Indian agriculture.

The second type of irrigation, again an age long custom, is the well, which is most typical of the regur lands, though it is found also on the red soils. Topography on the regur,which does not favour tank irrigation,is quite favourable to well irrigation, but the fact that to reach water in the trap regions the well may have to be bored some 20 to 40 feet down to the solid trap,and further that the existence of water is not certain when the well has been bored, makes it a risky proceeding. The subterranean water supply is not due to a continuous water layer, but to water held in fissures in the trap, and the peasant has not the capital to expend in boring a well, which may cost Rs. 200-400, [2] if he is not sure of a return. Moreover, the water from a Deccan well will irrigate only one-fourth of that which a well on the alluvial plains of North India will do. Hence, well irrigation on the Deccan is not extensive and is

1 Report Indian " Irrigation Commission," 1901-1903.
2 Dr. H. Mann—" Land and Labour in a Deccan Village," Study No. 2. Jategaon Budruk.

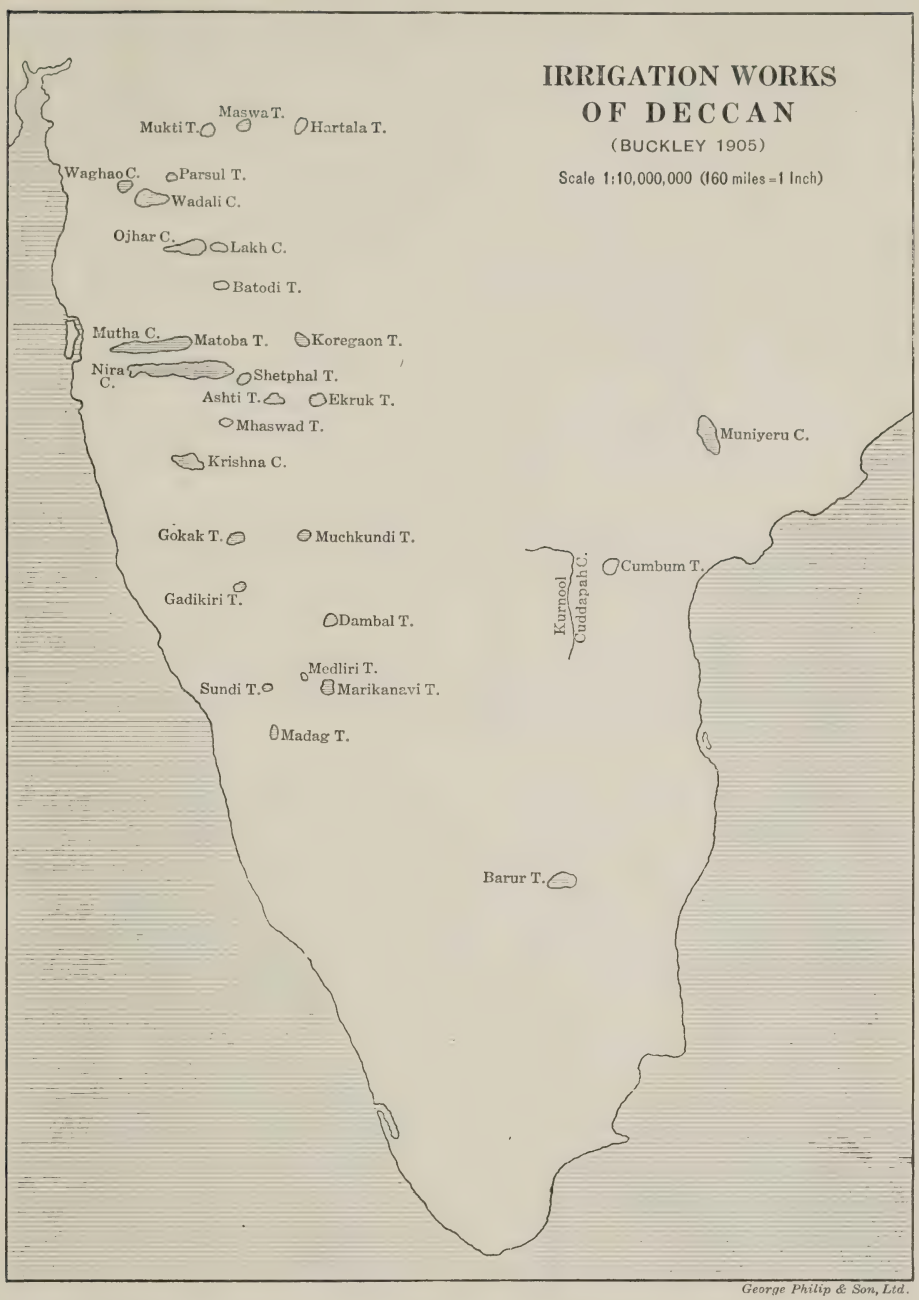


FIG. 10.

used only for small garden crops, rarely for anything more extensive. That well irrigation in the red soil regions is not great, is due to two factors; first, that the rock is so near the surface of the soil well boring is extremely difficult, and secondly, that the red soils are rice lands, and well irrigation is quite unsuited to providing an extensive water supply such as rice needs, owing to the difficulty and time required in raising the water.

The third type of irrigation, by canal, is typically a large scale Government enterprise, and is most developed in Bombay and Madras by the British Government. Particularly in the former, is it important, as shown by Fig. 10 from Buckley.[1] The occurrence of those canals along the Western Bombay Deccan is due to tapping of rivers, which are fed from the high rainfall regions on the upper slopes of the Western Ghats. The enormous advantages given to agriculture in the regions irrigated by these canals, is beyond question. (See Fig. 24, distribution of sugar cane). That they have not been further extended is due to several reasons. First, that they do not pay. None of them have yielded as yet a sufficient return for the outlay on them, which has been enormous. Secondly, their extension into the dry East Bombay Deccan is difficult, in that the level topography makes the conduction of water difficult, and, further, the rivers of the region are either dry water courses in the hot season, or scouring torrents in the wet season; any perennial irrigation must be fed from the heavy rainfall tracts of the Western Ghats. The grave necessity for irrigation in this region in view of the terrible famines which occur, is considered by some as sufficient reason for the extension of irrigation at all costs.

In Madras there is a large area irrigated by the Kurnoul-Cuddapah canal, and further schemes are in view to irrigate large areas by canals from the Tungabhadra river, which flows through some of the driest and most precarious rainfall tracts of the Peninsula.

There are numerous minor methods of irrigation on the plateau; small channels are often run off from rivers, or fields are embanked to conserve moisture and prevent erosion. Such methods are characteristic of the careful cultivator, and amply repay his labour.

Irrigation on the Deccan means many benefits to agriculture. It adds to the successful growth of a crop, by ensuring it sufficient water, which can be supplied as required. Moreover, by extending, as it were, the rainy season, it permits of the growth of longer maturing crops, which in many cases are superior to the quick maturing varieties of the same crop. By ensuring the success of agriculture it minimises the risks of famine. The following table from the "Report of the Indian Irrigation Commission 1901-3 shows the regions where irrigation is most required as a famine preventive on the Deccan.

Locality.	Av. Ann. R.F. in ins.	No. of dry years or years of severe drought that may be expected in 50 years :— Dry years including years of severe drought.	Years of severe drought.
C. Provinces E.	55	6	0
Satara, Belgaum, Dharwar	42	4	1
C. Provinces W. & C.	47	7	2
Madras S. & C.	31	7	2
Mysore	34	9	3
Berar	35	10	3
Hyderabad N.	35	11	5
Sholapur, Bijapur Ahmednagar	26	11	7
Madras Deccan	25	13	6
Hyderabad S.E.	26	11	8

1 Buckley—"Irrigation Works of India," 1904.

It can be seen that in those areas where irrigation is most required it is the least practised. The great certainty of the rainfall in the Central Provinces is reflected in the low frequency of famine and drought.

The importance of irrigation in relation to the growth of crops is best discussed in the next section of this study.

CHAPTER II.

CROP DISTRIBUTION on DECCAN as DETERMINED BY INTER-RELATION OF SOIL AND RAINFALL CONDITIONS.

CROP DISTRIBUTION.

Jowar and Bajri (*Figs. No.* 11 *and* 12).

Jowar or great millet holds a prominent place in Deccan agriculture, since it is the staple food crop, and also the most precious fodder crop over a great part of the plateau. Its distribution is mainly confined to the heavy or medium black soils, in regions with an annual rainfall less than 40ins. Very rarely is it found on the lighter soils unless irrigated, and rarely is it found in regions of more than 40 ins. rainfall, since too much moisture spoils the grain. Within the regur regions rainfall conditions vary considerably from the certain rainfall of the Nagpur region, to the uncertain and scanty rainfall tracts of the Madras Deccan and East Bombay Deccan, and yet jowar is grown throughout. The fact that Indian jowar can accommodate itself to very stringent conditions of climate is perhaps the most valuable single attribute which it possesses. The rainfall in most of the tracts where it is grown is very precarious ; long breaks in the rains with resultant high temperatures are common, and the rain when it does come may be a violent downpour, causing a big drop in temperature. In such areas the cultivator must have for his food crop, which is to keep him and his family alive, one which is hardy enough to withstand these unstable conditions, and yield him a good return for his labours. Such a crop is the Indian jowar, which provides him with nutritious food, and good fodder for his cattle also. It is most probably long centuries of adaptation to such precarious conditions which has made the jowar of India so hardy ; American varieties when introduced will not survive the unfavourable climate. Even Indian jowar will fail sometimes if the monsoon finishes early before the crop is ripe, and great importance is being attached by the Agricultural Departments, to the selection of strains of quick ripening varieties for use in famine time.

Though jowar is grown throughout the regur regions it shows decided concentration on the richer soils. A belt of very dense cultivation extends along the first class black soil tract of the Tapti valley in East and West Khandesh, through the plain of Berar,[1] to the Nagpur plain and the Wharda valley. The more certain character,and greater amount of the rainfall in this region make it more productive than any other part of the regur country. The jowar crop is sown after the beginning of the rains in June, and takes from $3\frac{1}{2}$ to 5 months to mature. It could be sown as a rabi crop, since the soils are very retentive, but the rabi crops of this area, commercial crops of wheat and linseed, are more profitable.

South of this belt an east-west spur of the Ghats, the Ajanta range, shows very thin jowar cropping. This is due to soil character ; the regur soils are replaced on the rugged lands by sandy red or shallow black soils unsuited to jowar cultivation, and bajri millet takes the place of jowar. South of this spur jowar cropping again becomes dense, particularly along the deep fertile soils of the Godaveri valley. This zone links up with the northerly one across the plains of Parbhani in Northern Hyderabad, round the eastern end of the Ajanta range.

1 Termed the " Payangat " of Berar.

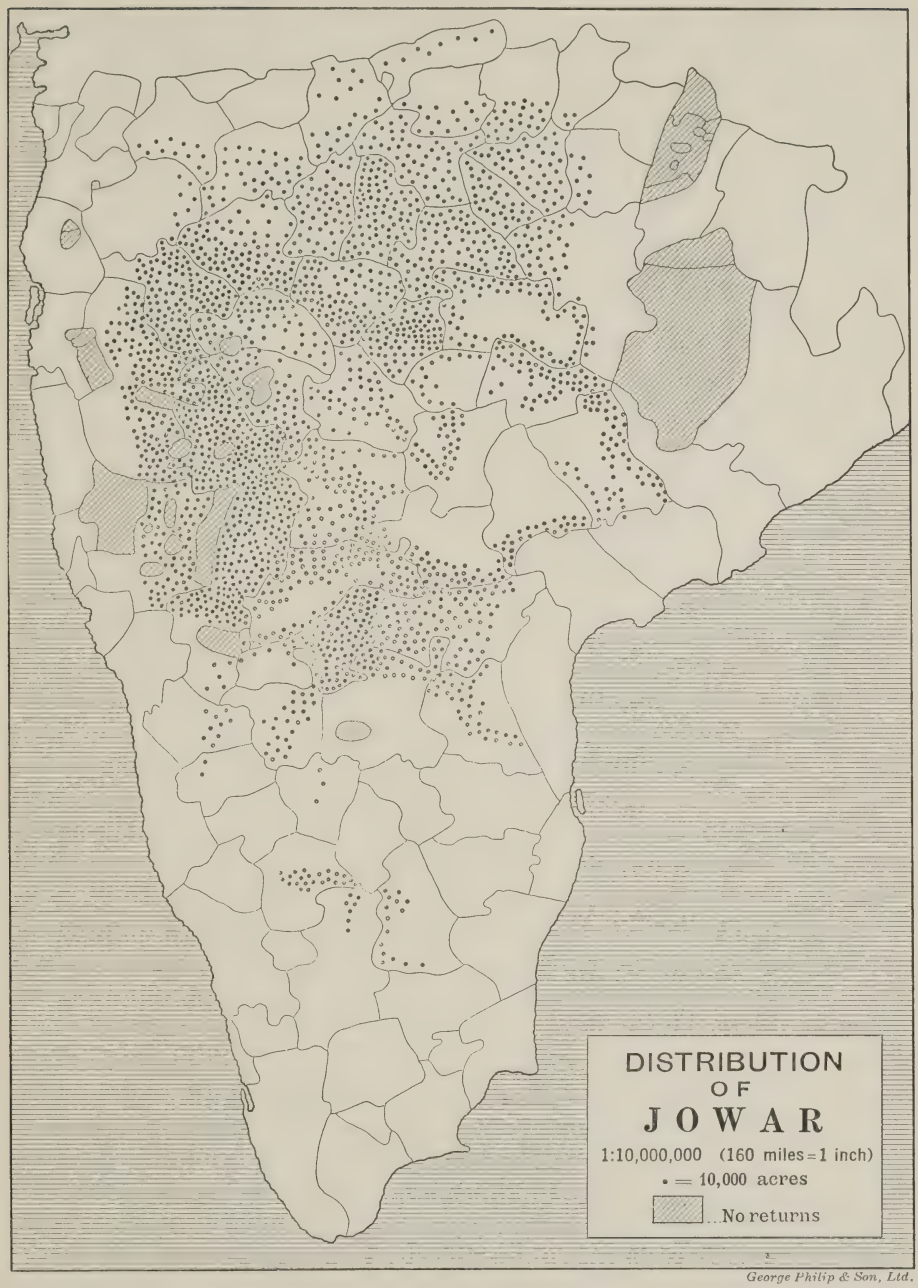


FIG. 11.

The Eastern Bombay Deccan shows very heavy cropping from the Godaveri valley in the north to the limit of the regur soils in the south. Jowar cultivation in this area is as dense as in the fertile valleys of the Tapti and Purna, although the soils are less rich, and the rainfall more precarious; in parts it is even denser. This is a result of the hardy nature of jowar as compared with the commercial crops of the northern valleys. The cropping of linseed, cotton and wheat shows a marked decrease, but jowar shows none.

The difference of soil fertility in the two regions is reflected in the average yield of the crop.[1] On the rich northern plains it yields 600-800 lbs. of grain per acre, while in the East Bombay Deccan the yield is only 400-600 lbs. per acre. The southern limit of this north south jowar zone is the boundary of the regur ; beyond, on the red soils, jowar is grown a little under irrigation. Its western boundary is determined by topography. As the land becomes more rugged on approaching the Ghats, the regur is replaced by lighter soils, and bajri replaces jowar. This is well shown in the Nasik region of the Bombay Deccan. The rugged land extends further eastwards here than in the river valley to the south, and the western limit of jowar cultivation bends to the east. The eastern limit of jowar cultivation, as on the south, is set by the extent of the regur soils, though it is grown on the red soils beyond, under irrigation in a small way. The irrigated red soils, however, are the rice domain. A large area of jowar cultivation, lies outside the main zone, on the regur lands of the Madras Deccan, in Bellary, Anantapur, Kurnool, and the Nandyal valley of Cuddapah. There are also small areas on isolated patches of black soil in Chitaldrug in North Mysore, and along the Cauvery in South Mysore. It is noticeable that a great part of the jowar producing area is a region of late summer rains ; this most particularly relates to the Bombay and Madras Deccan regions. In the former, an early and a late summer rainfall maximum permits of the sowing of both a kharif and a rabi crop. The significance of the late season rains in this area in relation to agriculture cannot be overestimated. The early summer rains are extremely inadequate and uncertain, and the kharif crops are liable to fail through long breaks. The September falls are the heaviest of the year, and the regur soils utilise them by storing them for the rabi crop. Very often in the region the rabi crop is the most important of the year ; the relative importance of kharif and rabi naturally varies with variations in the rains. If the early rains are good and the late rains bad then kharif is the principal crop ; if the early rains are bad and the late rains good then rabi is the principal crop.

On the Madras Deccan the rabi crop is the only one of the year on the regur soils. The rainfall curve for the region, taking Anantapur as typical, shows that the early summer rains are very low, and rise gradually to a maximum in September and October. So intense is the spring heat in this region, that the scant early rains are not sufficient to render the regur capable of cultivation, and the crop is sown in September or October after the heavy falls. The lighter varieties of regur may be sown in August, since they do not require so much moistening to make them workable.

Throughout the regur lands jowar is a " dry " or unirrigated crop. Only on the lighter soils is it a " wet " crop. In the Western Deccan districts of Bombay irrigated jowar is much grown as a fodder crop,[2] since it gives a much higher yield of stalk and leaf than " dry " jowar, and is ready much quicker. The importance of jowar as a fodder crop rivals its importance as a food crop. The cattle of the Indian ryot represent, after his land, his sole capital, and his most precious possession. Without them he cannot till his land, nor raise his water from the village well ; to perform these duties the cattle must be well fed. Of all the fodder crops of the Deccan, jowar yields the most nutritious product ; its value is told by this old Indian proverb " Does the bullock which is fed on cholam (jowar) long for heaven ?" Thus jowar has a two-fold significance to the cultivator.

It is apparent from a comparative study of the maps of jowar and bajri distribution, that, wherever in the jowar regions the heavy soil, primarily

1 Quinquennial Report on the average yield of Principal Crops in India, 1917.
2 Dr. H. Mann. " Fodder Crops of Western India," 1917.

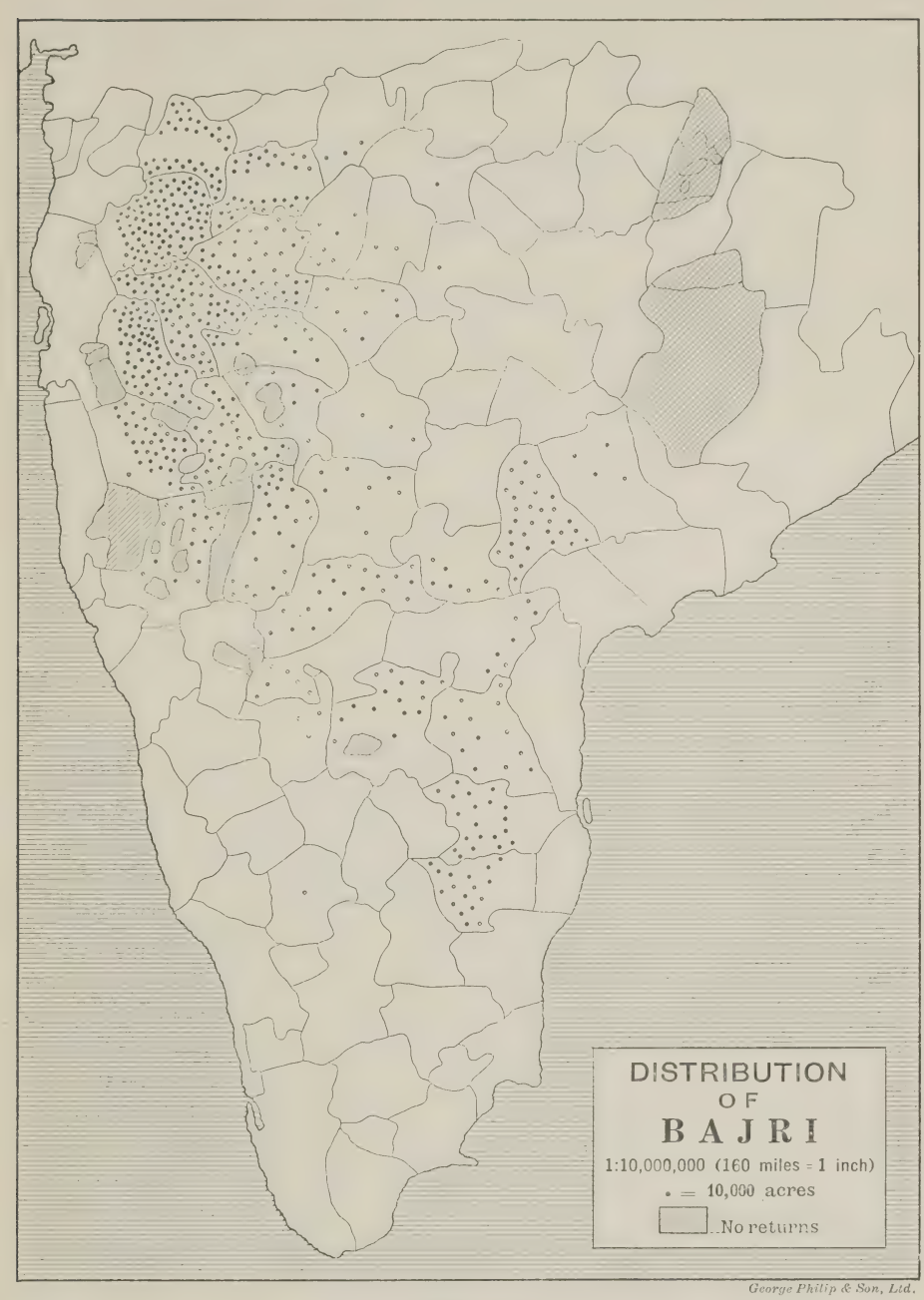


FIG. 12.

through topographical factors, is replaced by lighter soil, jowar millet is replaced by bajri millet. Bajri is grown extensively with jowar on the richer lands, but it is only in those parts where jowar can not be grown that it becomes pre-eminent, since it is inferior both as a food grain and as a fodder crop to jowar. Bajri, unlike jowar, is entirely a rain or kharif crop; this is because it is grown on the lighter unretentive soils, either red or poor black,

and such soils require frequent showers in order to grow a crop successfully. They cannot store water through the rabi season, and the crop is not grown under irrigation, since the soils are generally not good enough to irrigate. If irrigated, more profitable crops than bajri would be grown.

For maturity bajri requires less water than does jowar, hence when the kharif rains are deficient bajri is often sown on the heavy lands in place of jowar. Its distribution on the Deccan is best studied in relation to its main function ; this is as a supplementary food crop to jowar.

In the first zone of jowar cultivation along the Tapti and Purna valleys and the Nagpur plain, where the soils are very rich, bajri cultivation is negligible. Similarly along the river valleys where jowar showed such heavy cropping, bajri is absent. On the other hand, where on the jowar map there are blanks owing to lighter soil tracts, bajri shows extensive cultivation. This is apparent on the slopes of the Satpuras, north of the Tapti valley, and on the east-west spurs of the Ghats, to the south of the Tapti. Along the whole of the Bombay Deccan cropping is heavy, since it is grown with jowar, but its limit extends further to the west than that of jowar. This western limit is not set, as that of jowar is by soil type, but by rainfall amount. The rainfall limit is about 45ins. to 50ins., beyond this, the heavier rains permit of rice cultivation. The same feature is apparent to the east and south of the Bajri zone. Wherever as one proceeds south or eastwards to the regions of red soils and heavier rainfall, and irrigation becomes possible, rice becomes the staple food grain.

Pulse (Fig. 13).

Jowar and bajri are not the only food crops of the areas in which they are grown. Pulses are extensively sown either as rotation or mixed crops, along with the millets. Pulses have a particular significance in these associations. From the purely agricultural point of view they are most valuable in that being leguminous crops, they, by the action of the nitric bacteria on their roots, supply nitrogen to the soil. This is especially valuable to the soils of the Deccan which are very deficient in nitrogen. Not only are they valuable as manures in this way, but when ploughed into the soil after the pods have been removed they are good green manure, their stalks containing much potash. A second factor of importance is their time for growth. A pulse crop takes longer to mature than either a jowar or bajri crop, hence, by sowing both together the ryot obtains two crops—the pulse growing rapidly after the millet crop has been reaped. This fact is a safeguard in a very precarious rainfall tract like the East Bombay Deccan, since, if the millet crop fails, the cultivator has his pulse crop to fall back on. It is not likely that growing pulses as mixed crops with the millets has a detrimental effect on the latter. Pulses are very deep rooted crops, and therefore draw most of their nourishment from the lower layers of the soil, rather than from the upper layers as the millets do.

A further important point in relation to the pulses is that they, being highly nitrogenous, are an important and necessary complementary diet to the starchy millets.[1]

It would be too lengthy a task to survey all the pulses grown on the Deccan since they are numerous and extensive. The distribution of gram, as typical (Fig. 13), shows that their growth is not confined to the regur soils alone,—they are grown throughout the red soil country also, and are just as important as supplementary crops to rice, as to millets. Gram, or chick pea,

1 This aspect is more appropriately treated in relation to Rural Economy.

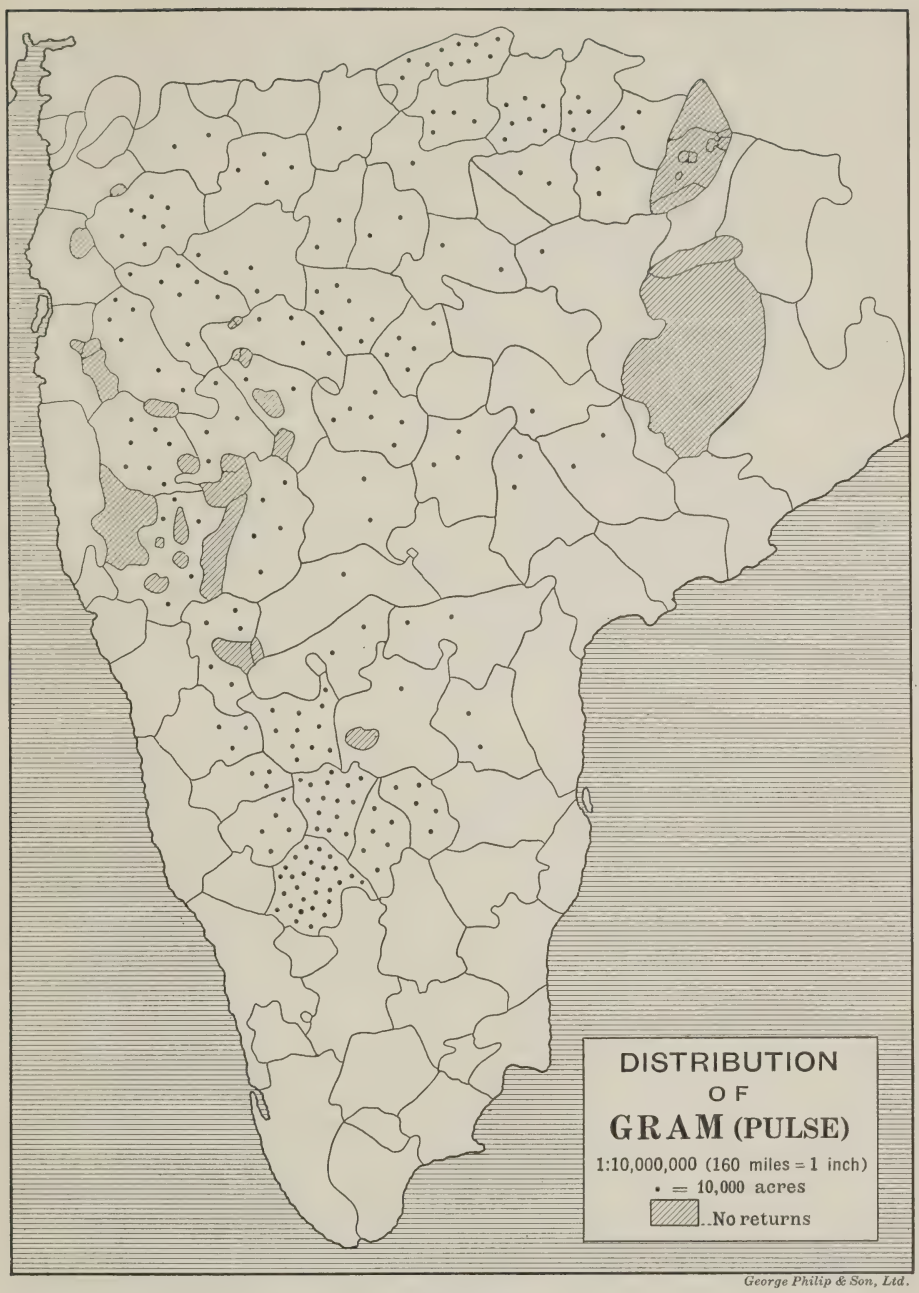


FIG. 13.

is a crop of the heavier soils. In the regur regions it is grown in the rabi season on the deep retentive soils in rotation with wheat and linseed. In the red soil districts it is grown on the valley soils, either as a dry crop after irrigated rice, or as an irrigated crop. It is a " rich soil " pulse crop, but there are very many which will grow on the poorer soils. Though not so strikingly important as the millets, pulses play a part not to be ignored in any study of Deccan agriculture.

Rice and Ragi (Figs. 14, 15, 16).

Rice and Ragi are striking in their distribution, in that they form a complement to jowar and bajri on the Deccan plateau. They are the crops of the red soil and heavier rainfall regions, where jowar and bajri are not grown, rice corresponding to jowar in that it occupies the richer soils, while ragi grows on the poorer upland soils, like bajri.

Rice is *the* great tropical food grain, and its pre-eminence lies in the fact, that it will grow under conditions which are fatal to other cereals. It is essentially a crop of warm regions, with a very heavy rainfall at the warm season. Where the rainfall is not heavy enough, naturally irrigation must be applied, since for successful growth rice is best under water for some months. The soil required is a fertile loam, not too clayey, or it will not dry easily when the water is drawn off for the crop to ripen.

The optimum conditions for rice growth are found on the low lying plains of the tropical rain lands, where the soil is fertile silt, and the rainfall is either heavy enough, or irrigation is easy. One quotes the river deltas of the Mahanadi, Godaveri, and Ganges as typical rice lands of India, but the distribution of rice in South India, is by no means confined to such regions ; it is extensively grown on the plateau, where it is confined to the rich valleys of the red soil regions, wherever topographical and rainfall conditions favour irrigation. The heavy soils, and lack of irrigation facilities, exclude rice from the regur lands. Even were the topography suited to irrigation, the uncertain rainfall would militate against any successful growth of rice.

Where on the plateau the rainfall is too low for unirrigated rice, it is grown generally under tank irrigation ; a comparison of the irrigation map (Fig. 9) with the map of rice distribution, shows great coincidence. It is extensively grown on the Mysore plateau in the valleys, and, here, owing to the well distributed rainfall, on which tank irrigation necessarily depends, three crops are grown in a year. The first is grown during the kharif season dependent on the kharif rains ; the second, dependent on the water stored in the tanks from the autumn rains, and the third, in the hot season, dependent on the water left over from the cold season, supplemented by the spring rains. From Mysore the rice zone extends northward on the red soils of the Madras Deccan to the Telingana or red soil country of Eastern Hyderabad. The rainfall in this region is much more certain than in Western Hyderabad, and tank irrigation is practised. Here rice is grown as it was in Mysore, on the valley soils, but, owing to the one season rainfall, one, or perhaps two, crops are the normal. The cultivation of rice continues northward, on the red soil regions, to reach its greatest density on the plateau, in the Wainganga valley of the Central Provinces. The valley is wide and level, and the soils are fertile brown or red loams. The rainfall is heavier than for any other part of the Deccan, approaching 50ins. in the north east, and irrigation in the area is very highly developed ; all these factors combine to make it a big rice growing area. We may take the Wainganga valley as showing the definite transition from Deccan agriculture with its scanty and uncertain rains, to the more favoured agricultural regions of the Mahanadi and Ganges basins, where the soils are rich, and the rainfall high and assured.

A narrow strip of rice cultivation extends along the slopes of the Ghats in the Western Bombay Presidency. It is limited on the east by the 50ins. isohyet ; beyond this bajri is grown. On the western side it is continued up to the Ghat crests. The soils along these higher slopes are not the red sandy soils of the bajri zone, but are lateritic soils, derived from the laterite cappings

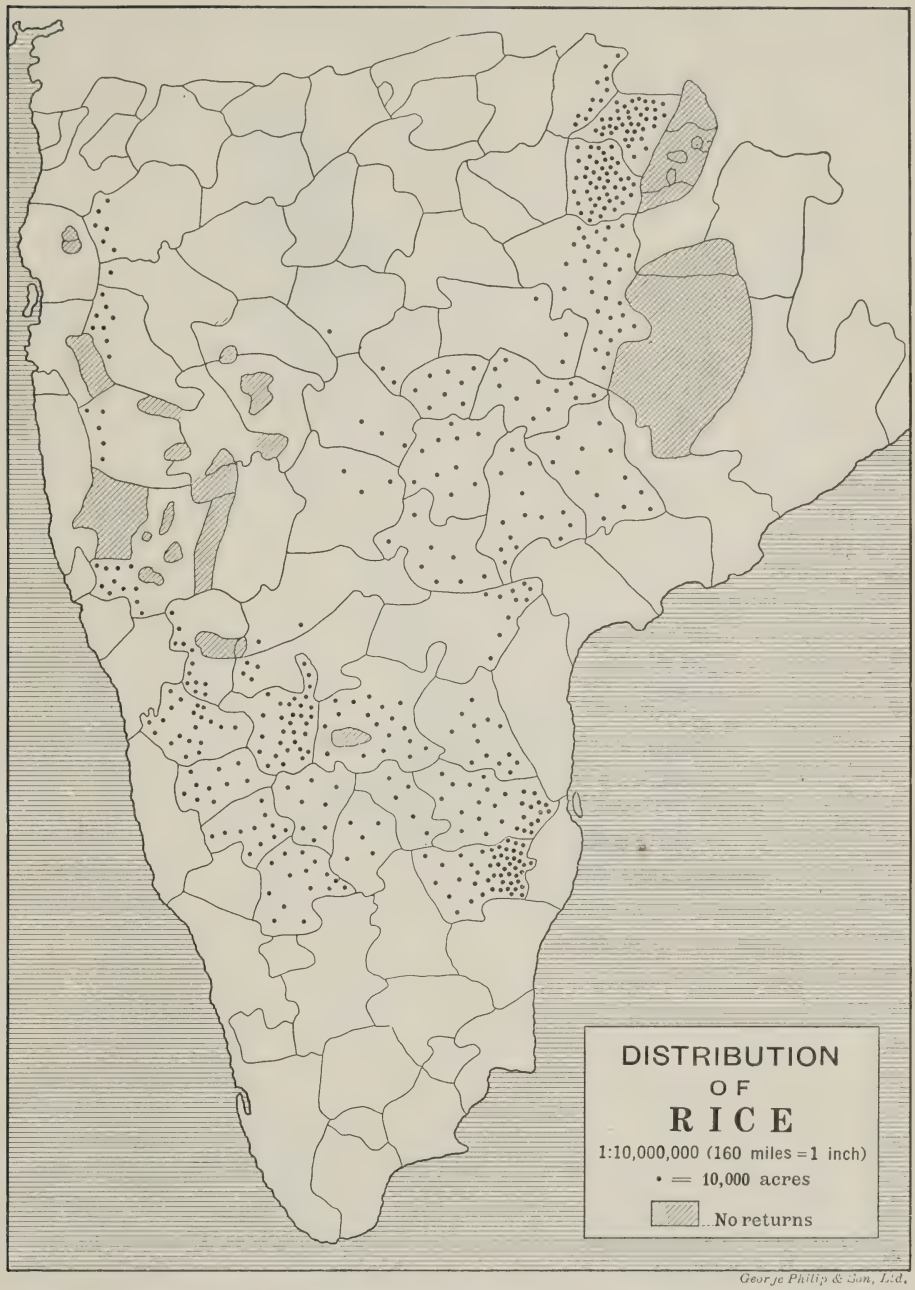


FIG. 14.

of the Western Ghats, formed under conditions of high rainfall and temperature. These laterite soils are superior in depth and fertility to the poorer varieties of red soil. Rainfall conditions are such that rice here can be grown without irrigation, save where it extends eastward beyond the 50ins. isohyet along the river valleys. The crop being dependent on a one season rainfall, is necessarily a kharif crop. The region may be taken as a continuation of

FIG. 15.

the real rice zone of the Bombay Presidency, that of the west coast plain and slopes of the Ghats, in Kanara, Thana, Malabar and Ratnagiri. Both regions grow unirrigated rice dependent on the south west monsoon. Rainfall on the coast zone is much heavier, since it is on the windward side of the Ghats, and gets the first benefit of the monsoon. Soil conditions are very similar in both regions, much of the soil on the west coast slopes and plains

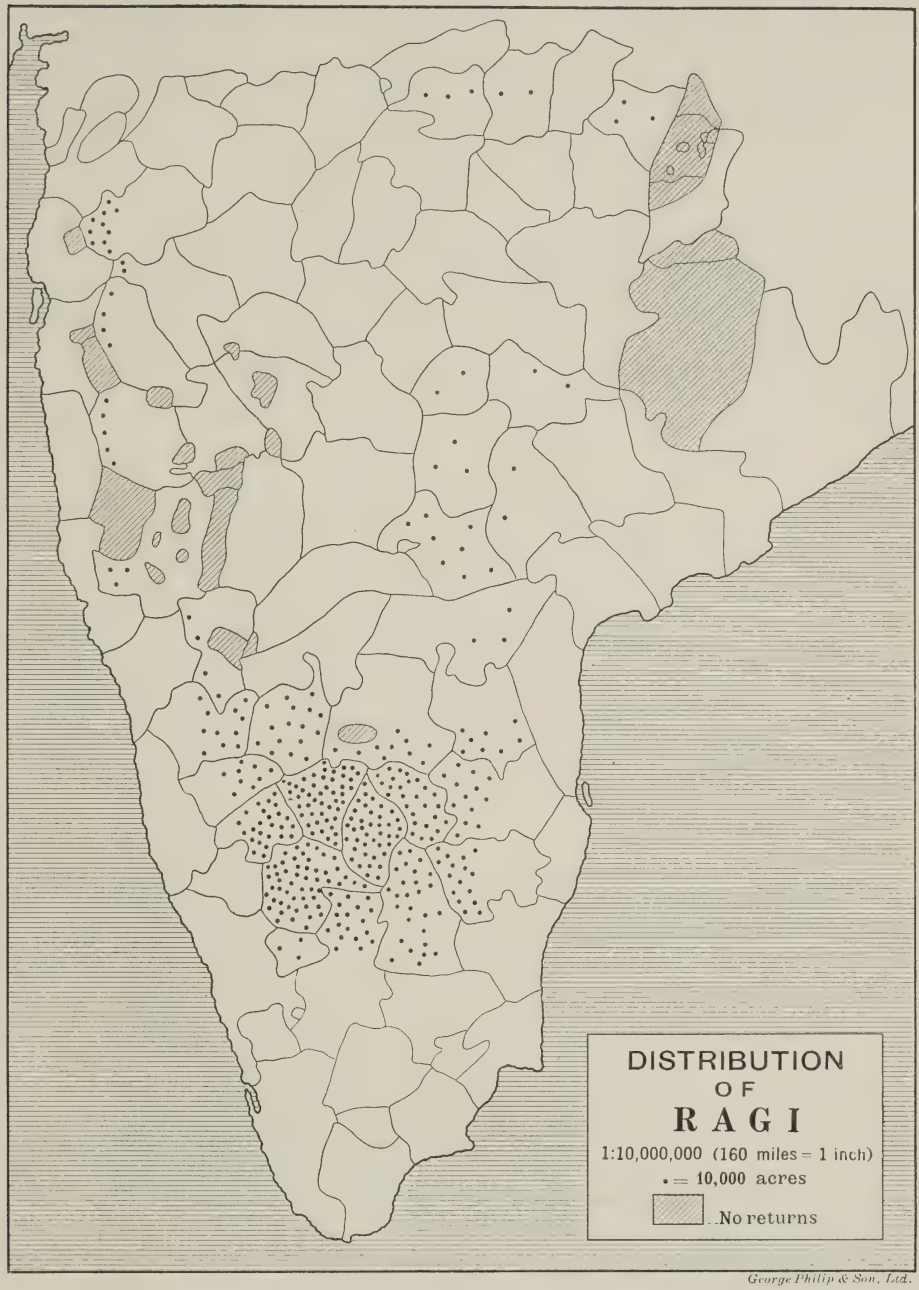


FIG. 16.

being low level, or detrital, laterite, brought down from the Ghat crests.

In Southern Dharwar and Belgaum this north-south strip of rice cultivation extends further to the east; this because of soil and rainfall factors. The soils of this region are red loams, similar to those of the Mysore plateau, and rice is grown there, as in Mysore, under irrigation in the valleys. Rain-

fall conditions are more favourable than might be expected from the location. An examination of the Ghats in the neighbourhood, shows that they are much lower and broken than to the north or south, and the fact is strikingly reflected in the rainfall figures. Belgaum has 49.3ins. per annum, Dharwar 32.65ins., while at Sangli and Miraj, some distance to the north, the rainfalls are only 25.29ins. and 24.25ins. respectively. Further eastwards from Dharwar, Gadag has only 25.04ins. This accounts for the fact, that though soil conditions are suitable further eastwards, rice cultivation is limited.

Two distinct varieties of rice are grown in the Presidency as a result of physical conditions, an upland and a lowland type. The former is inferior to the latter, yielding a much coarser grain. It takes only ninety to a hundred and twenty days to mature, and thus requires less moisture. These varieties are very valuable in a time of water shortage. The lowland varieties on the richer soils, take from 120 to 180 days to ripen and require much more moisture. They yield a much finer grain. Cultivation on the slopes is done only by a careful system of terracing, and embanking, the embankments reaching 18ins. to $2\frac{1}{2}$ feet.

A feature of rice cultivation in the Presidency is the " rab " system.[1] This consists in the burning of twigs and leaves on the rice ground before sowing, the ash forming a valuable manure. It is practicable only when the jungle is near to the rice growing tracts, as it is in these regions. The separate holders of rice lands, are allotted portions of jungle in their respective villages, where they may collect their material. " Rab " cultivation is also limited by rainfall, since it requires much water to make the ash soluble in the soil. Its main sphere is, therefore, the western side of the Ghats, but it is practised to some extent on the leeward slopes also. It disappears passing eastwards to regions of lighter rainfall, and, states Dr. Mann, " the finer varieties of rice appear to vanish with rab."

Ragi (Fig. 16).

Ragi is the supplementary food crop of the rice regions, occupying the poorer upland soils between the rice valleys. It can be grown on the heavier soils, and here its yield is great,but it is typically the poor soil crop. It is particularly valuable in that it takes only four months to mature, and though inferior as a food crop both to jowar and bajri,yet it is a valuable crop for famine time. It is grown throughout the rice region, but shows a very striking nucleus of cultivation on the Mysore plateau, where it is the staple food grain of the poorer classes. The area under ragi is much greater than that under rice, showing the very limited extent of rich soils in the region. It is grown practically always as a dry crop, either as an early season, a mid-season, or a late season crop dependent on the well distributed rains. The rice region of the Wainganga valley shows no ragi cropping. This is due to the fact that the soils are too rich to be devoted to an inferior millet ; they are rice, wheat and linseed lands throughout.

Wheat (Fig. 17 and 18).

Wheat in Indian agriculture is important both as a food crop and as an export crop. The main wheat zone of India lies not on the Deccan, but in the Punjab and United Provinces, which produce about 75 per cent. of the total wheat crop; nevertheless it is an important feature of crop production in parts of the Plateau.

1 Dr. H. Mann—" Rab System of Rice Cultivation," Memoirs Dept. Agric. India. Chemical Series, Bull. No. 3.

Wheat is typically a cereal crop of the temperate regions of the world, where it is either a spring sown wheat, or a " winter " wheat. The former has a short growing season, about five months, and is characteristic of the steppe land climates of the temperate zone, where the winters are too severe for " winter " wheat. The latter is typical of the temperate lands, with a cool moist winter and a warm dry summer, and takes about nine months to mature. English wheats are generally " winter " wheats.

The growth of wheat in a land like India is due to the peculiar sequence of the Indian seasons. Her wet season is followed by her cool season, and her cool season by her hot season, and that again by her wet season ; hence she can sow her wheat crop after the late rains of September and October, it will grow during the cool season, and ripen at the beginning of the hot season ; the heat becomes too intense as the hot season proceeds, hence the crop is harvested at the beginning. It takes about five months to mature, and thus is similar to the " spring " wheats of the steppe lands.

Wheat requires moisture during its growing period, and, since no rain falls during the cool season on the Deccan, and wheat is rarely grown under irrigation, it can be grown only on those soils deep and retentive enough to conserve sufficient moisture from the late rains, to carry the crop through to maturity. Thus it is that the typical Deccan wheat lands are the heaviest black cotton soils, though it is grown to a small extent throughout the regur zone. Always it is a rabi crop, since it is totally unsuited to the warm wet kharif season. The map of wheat distribution (Fig. 17) shows that the densest areas coincide with the heavy soil belts of the plateau. A heavily cropped zone extends along the Tapti valley of Khandesh, through the Purna valley of the plain of Berar, to the Wharda valley and the Nagpur plain. On many lands in this belt it is the main crop of the year, since the heavy soils often become incapable of cultivation in the wet season owing to their great depth and insufficient drainage, and are workable only in the rabi season. Wheat, on these lands, is grown in rotation with linseed, also a rabi crop, with very similar requirements to wheat, as shown by the similarity of their distribution (Fig. 23). Linseed requires for maturity less moisture than wheat, and often replaces it in years of deficient late rains. North of the Nagpur plain, wheat is grown in the richer valleys of the uplands of Chindwara and Seoni and Betul, where the higher rainfall compensates for the lighter quality of the soil.

From the black soil wheat belt, cultivation extends eastward to the fertile dark brown and black loams of the Wainganga valley ; here it is still a rabi crop rotated with linseed. The soils are not as heavy in this region as on the regur lands, but the rainfall is much heavier and compensates for soil deficiency in retentiveness. Moreover, the valley, being rice land in the kharif season, is under tank irrigation, thus a deficiency of late rains could be assisted by irrigation. Normally, however, the crop is unirrigated. These wheat tracts of the Central Provinces, though important, cannot be compared with the great wheat lands of the Narbada valley north of the Satpuras, nor even with the regur plains to the east ; they are mainly rice lands.

South of the great northern wheat belt of the Deccan, the lighter soils of the Ajanta range do not permit of wheat cropping, but as the Godaveri valley to the south of it is approached, the crop again becomes important. The distribution map shows a zone of production widening in the west on the fertile plain of Kopergaon in Western Nasik, and passing eastwards into a narrow ribbon of cultivation along the deep black soils bordering the river. It widens again further east to the plain of Parbhani in Northern Hyderabad

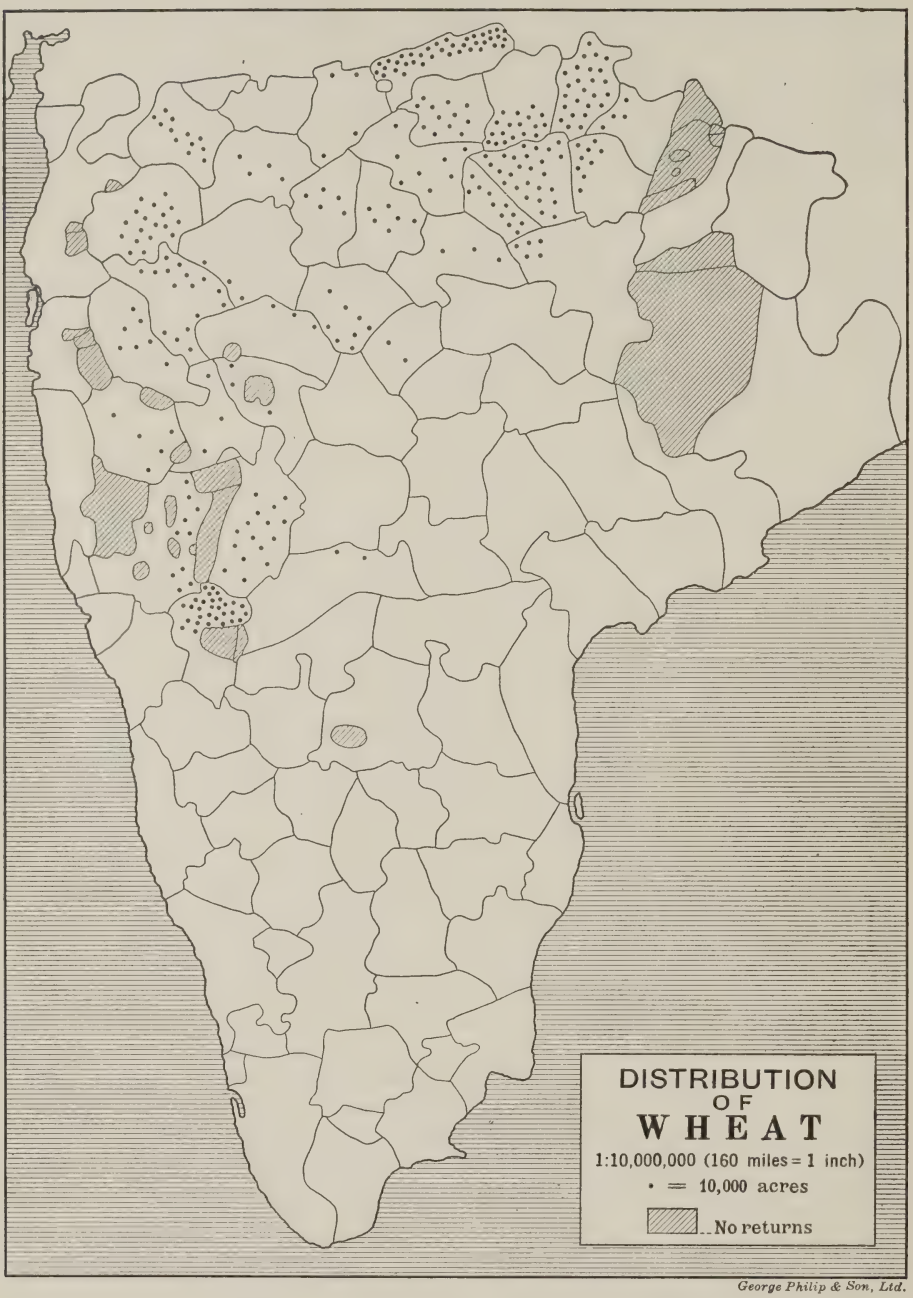


FIG. 17.

and the Dudna river valley. Its eastern limit is determined by the extension of the regur soils, beyond which it is replaced by rice.

South of the Godaveri, along the Eastern Bombay Deccan, wheat is grown throughout as a rabi crop on the heaviest lands, but owing to the moderate depth of the soils, and the great uncertainty of the rains in the region, pro-

duction is not nearly so extensive as on the belts to the north. On approaching the south of the East Bombay Deccan, however, wheat cropping increases in intensity, in Bijapur, eastern Belgaum and north eastern Dharwar. This increase is due both to soil and rainfall factors. The soils are of a better quality than to the north particularly in north eastern Dharwar, and in the Kistna and Dhon valleys. The region also experiences heavier late rains than to the north ; at some stations the maximum of the year is recorded in October. Thus any deficiency of soil type is made up by rainfall amount, and accounts for the heavy wheat cropping in the area.

Outside the areas discussed wheat is not grown on the Deccan. The red soils are not suited to it, and the regur soils of Madras which, though rabi lands, grow one crop a year only generally, are devoted to cotton and jowar.

Character of Deccan Wheat.

The character of wheat grown on the Deccan is a result of the shortness of the growing season, and the climatic conditions prevailing through it. Deccan wheat takes only five months to mature as against nine months for English wheat. This hastening to maturity because of the hot dry spring helps to give the grain the character known as " hardness " in the wheat market, in contradistinction to the slow maturing " soft " wheats. The main factor in the hardness of Deccan wheat however is probably the scarcity of water, since it has been proved by experiment that hard wheats under irrigation tend to become soft.[1] The table below shows the effect of irrigation on a hard red wheat of the Nagpur plain.

Kathia.	Per cent. of composition of final samples of :—		
	Hard grain.	*Spotted grain.*	*Soft grain.*
Irrigation.			
Nil	92	8	—
Light	74	22	4
Heavy	1	12	87

Soil conditions also seem to effect the grain considerably, the lighter soils producing a harder grain than the heavy soils, this probably being due to the fact that they retain less moisture. The following table shows the effect of soil type on the Jalalia variety of hard wheat from the Central Provinces.

Sandy Soils.	Per cent. of composition of final samples of :—		
	Hard grains.	*Spotted grains.*	*Soft grains.*
4 times irrigated	99	1	—
Black clay—			
No irrigation	87	11	2

Not only is the grain much harder on these sandy soils, but the growing season of the crop is shorter, and the yield much lower than on the heavy soils. The composition of the grain also varies in relation to climatic conditions, in that the hardest wheats have the highest nitrogenous content and the softest wheats the lowest. This has been related by Dr. Lyons to the small supply of soil moisture causing a restriction of the kernel,[2] " a moderately cool season with a liberal supply of moisture has the effect of prolonging the period during which the kernels develop, thus favouring the filling out of the grain with starch, the deposition of which is much greater at that time than is that of the nitrogenous material. A hot summer shortens the period

1 Evans. Dept. Agriculture Central Provinces " Wheat Variation."
2 Quoted by Rutter—" Wheat Growing."

of kernel development, curtails the deposition of starch, and leaves the percentage of nitrogen relatively higher." It is to their short growing season that the Indian wheats owe their high nitrogen content, and their resultant "beany" flavour, which makes them unsuited, by themselves, for bread. They are valuable, however, for mixing with the sweet and milky-flavoured soft wheats, which by themselves are also poor for bread making, in that they lack what the hard wheats possess—strength. By "strength" is meant the capacity of the flour to make a large and well-shaped loaf, and, though strength sometimes is present in soft wheats, it is more generally associated with hard wheats. What particular constituent of the grain gives the strength is not yet determined. It was supposed that it was due to the high gluten content of hard wheats, but it has since been proved that wheats with low gluten content may possess strength. Invariably, however, hard wheats are strong wheats, and are required for mixing with the soft wheats for good bread flour, particularly in England where the wheat crop is "soft."

Two types of hard wheats are grown on the Deccan, bread wheats, and *durum* or macaroni wheats. Both types are used for home consumption, the native preferring the hardest types, and both are exported—the bread wheats mainly to England and the macaroni wheats to Southern Europe. The durum wheats are the hardiest of the two, and are grown on the lighter soils, while the bread wheats are grown on the heavier soils. On the Nagpur plain, and the red soil districts of Bhandara 60 per cent. of the wheats are hard yellow macaroni wheats, which are partly used for home consumption and partly for export. The remaining 40 per cent. are hard red wheats which are exported to England as "Balaghat red" or retained for home consumption.

Throughout the Deccan the varieties grown are types of hard red, yellow or white wheats. A curious hard red wheat known as "spelt" is grown on poor soils, as a kharif crop, in Mysore and Madras. It is only scantily grown, but is important in that it is "rust" proof, and may be used to evolve a strain of rust resisting wheats in the Central Provinces. "Rust" is the great wheat scourge throughout the wheat regions of the world, and though the cause of it is difficult to determine, it is hoped to evolve a rust-resistant wheat. Howard[1] estimates a loss of 10 per cent. on the Indian wheat crop because of rust. The growing of wheat for export in India, has only become possible since three occurrences, the opening of the Suez Canal in 1869, the repealing of the export laws against Indian wheat in 1873, and the opening up of the wheat tracts by railways in the late 19th and early 20th centuries, giving them access to the ports of export. The export since then has fluctuated considerably, owing to the uncertain character of Indian agriculture ; when the rains fail the land must go under food, and the export crop is thus diminished. The Indian wheat trade will receive stimulus from the growing demands for hard wheats. The old stone milling machines were not suited to the milling of hard wheats, but to the modern steel mills it does not matter whether the wheat be hard or soft. Hence hard wheats have a big demand which India may find it profitable to supply.

The Agricultural Departments have realised that if India must assume a position in the wheat world, she must improve her strains of wheat, evolving those which are rust resistant, hardy, and giving a high yield of good grain. On the Deccan the main requirement is a drought resisting, quick maturing variety. The crop has only a very short growing season since it cannot be sown until the October rains are over, and must be reaped before

1 Howard. "Wheat in India."

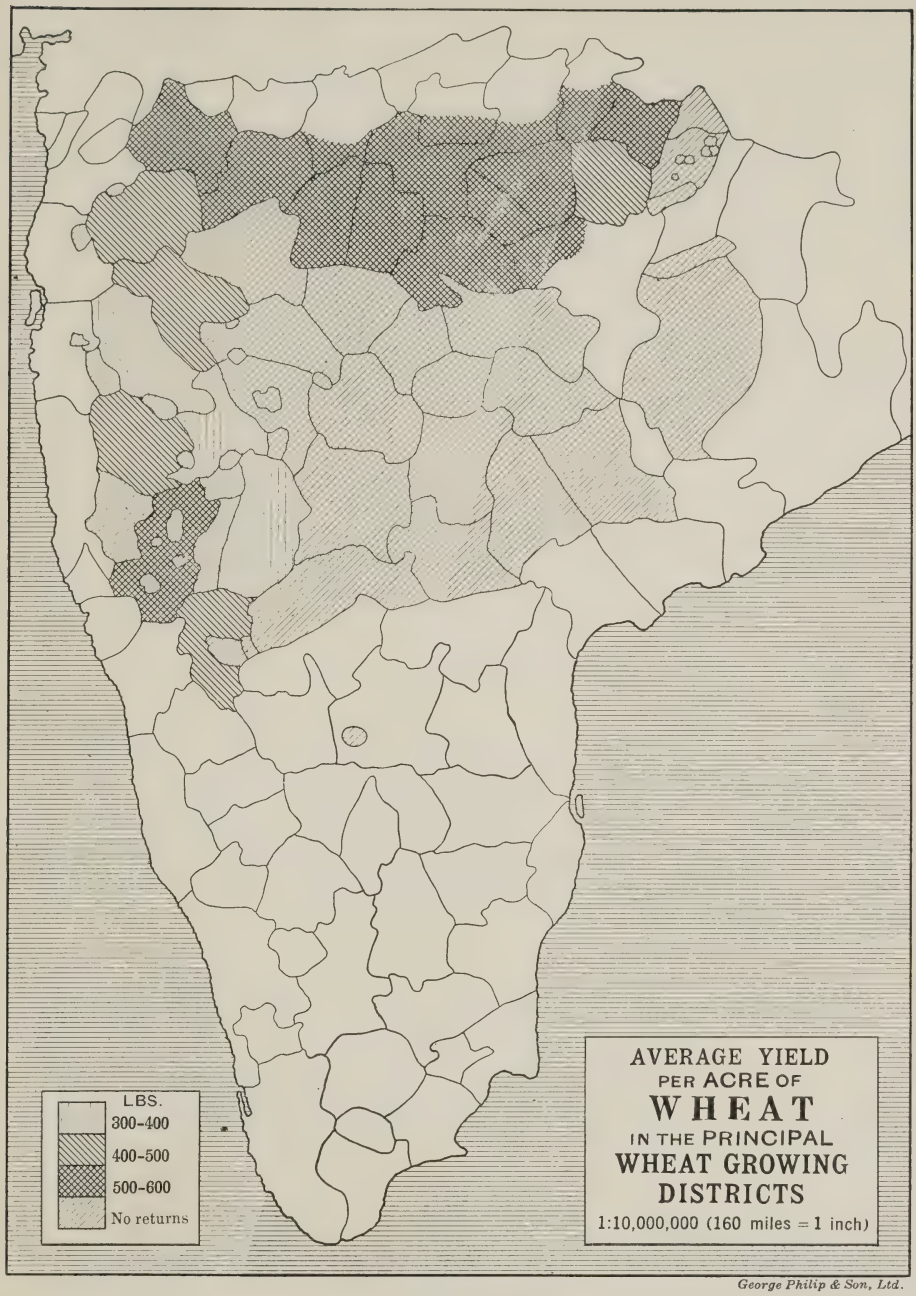


FIG. 18.

the hot spring winds dry up the grain. Since the hastening of maturity by the heat causes smaller kernels and lower yield, the aim is to get an early flowering variety, which allows of a longer time between flowering and fruiting, with a resultant larger kernel and higher yield. Howard is of the opinion that—" in spite of her short growing season, India is well adapted for the growth of wheat of the finest quality."[1]

1 Howard. " Wheat in India."

Cotton (Figs. 19 and 20).

India has always been a big cotton producing country ; up to the end of the eighteenth century she was one of the main sources of raw cotton for Great Britain, but, with the improvements in the cotton industry requiring longer and finer stapled cottons, and the increasing export from the United States of these finer varieties after 1878, India lost her place in the Lancashire market. This was essentially due to the character of the Indian cottons, which are all of too short a staple for the Lancashire market, being mostly well under 1in. in length. This essential character of Indian cotton is primarily the result of the physical conditions in the country.

The vital and determining factor in cotton growth is climate : " No chemical composition or mechanical state of the soil, will compensate for unsuitability of climate," [1] and " we see the effects of the proportions in which the different physical agents, light, heat and moisture are applied, in the length of what is technically the same plant."

The growing and maturing of the cotton plant takes about six months, and it requires an equable and settled climate, with a temperature 65° to 80°F. during the growing season ; sudden changes of temperature are bad for cotton, as for any other plant. The soil must be kept in a moist condition to ensure successful growth ; too dry a soil makes the plant dwarfed, too wet a soil causes it to run to leaf at the expense of fruiting. The best soil in view of these requirements, is a deep medium loam, which is retentive of moisture and well drained ; the mechanical structure is a more important factor than chemical composition.

Cotton is much affected by the vagaries of the weather. Heavy rainfall or high winds at flowering or fruiting time will damage the bolls and greatly reduce the market value of the crops. (So also will a " killing " frost, though this does not enter into consideration in Deccan cotton growing). Excessive drought causes a shedding of the bolls, and unripe cotton is practically useless, since it is weak and brittle. Further, factors such as sodden soil and damp close weather, foster the growth of diseases and insect pests, very detrimental to the fibre.

In view of the erratic character of the Deccan climate, cotton cultivation would be an enormous risk, were it not that Deccan cottons like Deccan jowar, have, through long centuries of adaptation to these conditions, become hardy enough to withstand them, and the failure of many of the introduced varieties is largely due to these very stringent climatic conditions. A brief comparison of the cotton season in India and in the United States, will show the fundamental differences.

The climatic year of the cotton districts of the United States has two definitely long seasons, a warm wet summer, and a cold winter, which pass into each other gradually. Cotton is a summer crop, requiring heat and moisture together, and the length of its growing season is determined by the occurrence of the first killing frost. This is the limiting factor in cotton growth northwards, since the growing season is necessarily shortest in the north and longest in the south. The finer varieties require a long growing season, which is normally six to seven months.

The Indian climatic year presents an entirely different set of conditions, which make the cultivation of any crop that requires a long season of any

1 Forbes Royle. " Cultivation of Cotton in India."

particular climate impossible. It is characterised by three short seasons, a warm wet season, a cool dry season, and a hot dry season. Not only are these seasons widely different, but the transitions between them are rapid. Such sudden changes are bad for any plant, and the successful crops under such conditions are those which will mature within a season. Their growing period is thus very short, being $3\frac{1}{2}$ to $4\frac{1}{2}$ months. It is this fundamental fact which militates against the cultivation of a longer stapled and finer variety of cotton in India ; any growth of such a type is bound up with the extension of the growing season, and this on the Deccan means irrigation.

Distribution of Cotton Growing on the Deccan.

The regur lands are the cotton lands par excellence of the Deccan, this being reflected in their name, black cotton soils. Their value as cotton soils lies in their great fertility, and, more important than this in a land of scant rain, their great retentivity. The crop is almost absent from the red soil tracts save in a few favoured parts. They are neither sufficiently fertile nor sufficiently retentive for successful growth of the indigenous cottons. On the regur lands, those areas most heavily cropped with cotton are the richest deepest soil tracts, and, though it is grown throughout on the medium black soils, it is absent from the higher rugged lands of the West Bombay Deccan, the Ajanta Range, and the Central Hyderabad range, thus presenting a marked similarity to jowar distribution.

The densest and most extensive belt occurs along the deep soil valleys of the Tapti and Purna, in Khandesh and Berar, and it widens eastwards over the Nagpur plain and the Wharda valley, its eastern limit being the termination of the regur soils. This is the richest land of the whole Deccan, and it is heavily sown, not only with cotton, but with jowar, wheat and linseed. Cotton is mainly grown here as a kharif crop dependent on the rains from June to October. The rainfall in this region is more assured and heavier than on the regur lands to the south, and the regime admirably suits cotton growth. The crop is sown as soon as the ground is in a workable condition after the rains in June, and receives an increasing rainfall till July, in the early stages of its growth. From July the rains lessen, and the crop ripens with a decreasing and not an increasing rainfall. This is important; in the Eastern Bombay Deccan where the rainfall curve shows a September maximum, the ripening cotton often suffers from the heavy falls.

The cotton types grown in this area are short stapled varieties, $\frac{3}{8}$in. to $\frac{5}{8}$in., grouped under the term "Oomras." Of these varieties some, such as "roseum" will yield a longer staple, but, since this is at the expense of their yield and ginning out-turn, the native cultivator prefers to grow his more prolific short stapled varieties. Moreover, he is not guaranteed a better price for his superior cotton. Hence it is held by many authorities on the subject, not only in the Central Provinces, but throughout the cotton growing districts of India, that if the native is to grow a better cotton, which is a more risky crop to rear, and one which yields him less than his poorer crop, he must be guaranteed a certain market and a minimum price to compensate.

These indigenous varieties, being inherently short stapled, and moreover confined to a growing season of $3\frac{1}{2}$ to 4 months, can never produce a staple long enough for the fine cotton industry of Lancashire, but if a staple of $\frac{3}{4}$in. to 1in. can be obtained by careful breeding and cultivation, they will become more valuable for the coarser industries of Lancashire, and the finer industries of India.

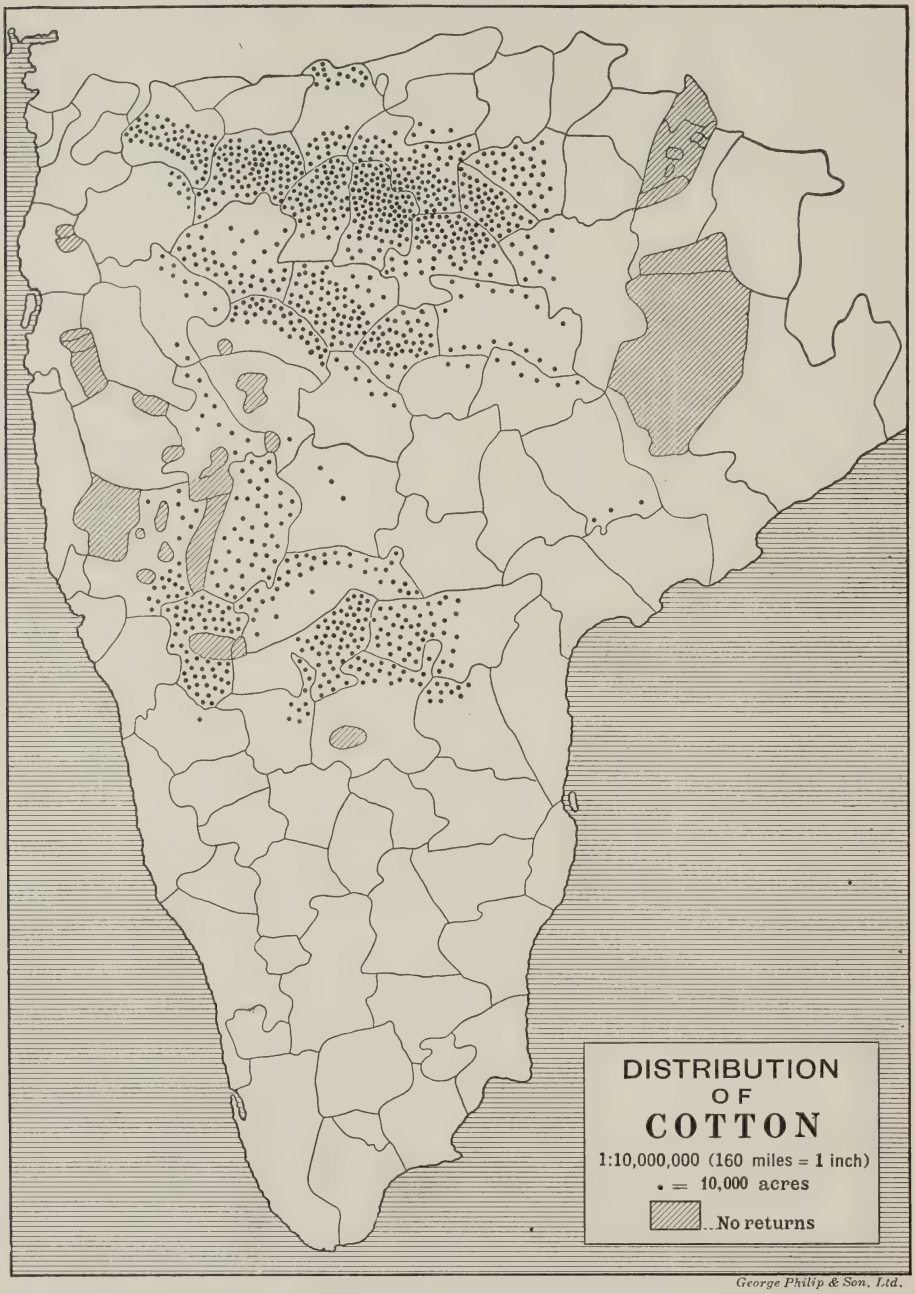


FIG. 19.

An interesting example of the influence of rainfall on the staple length is shown within this belt. The staple in Khandesh is shorter than that in Nagpur, being only $\frac{3}{8}$in. to $\frac{1}{2}$in. That of Berar is intermediate between the two. The following rainfall figures show that the rain not only increases passing eastwards, but the season is slightly longer. Moreover the rainfall to the east is more certain.

June	July	Aug.	Sept.	Oct.	Nov.	
3·94 ins.	7·98 ins.	5·29 ins.	3·93 ins.	·81 ins.	·18 ins.	Shirpur, W. Khandesh
4·5 ,,	8·94 ,,	6·14 ,,	5·47 ,,	·88 ,,	·27 ,,	Bhusaval, E. Khandesh
6·37 ,,	9·04 ,,	6·98 ,,	5·5 ,,	1·61,,	·35 ,,	Amraoti, Berar
8·57 ,,	13·85 ,,	10·48 ,,	8 ,,	1·96,,	·5 ,,	Nagpur, C. Provinces

This well bears out the statement that " In India different cotton growing tracts are bounded generally by isohyets, the quality of cotton varying directly with the rainfall."[1]

South of this great northern Valley belt, the cotton zone is broken by the east-west Ajanta range with poor, thin soils, but reappears in the Godaveri valley to the south. Cultivation is extensive along the rich deep soils of the valley, from western Nasik in Bombay, to the plains of Parbhani and Nander in Western Hyderabad. The zone terminates eastward at the limit of the regur soils, but a narrow strip extends further to the east along the black soils carried down the valley. Owing to the lessened extent of the rich soils cultivation is not so great as in the northerly belt, and rainfall conditions here being less certain than to the north also contribute to reduce the intensity of cultivation. These facts are borne out by a comparison of the yield of the crop in the two areas (Fig. 20). In Khandesh the yield is 110 lbs. per acre, in Ahmednagar 90 lbs. per acre.

South of the Godaveri the belt is again broken by the east-west Hyderabad range, on the poor soils of which cotton is not grown. South of this a belt of cultivation extends along the whole of the Eastern Bombay Deccan from north to south, through Ahmednagar, Sholapur, Bijapur and Dharwar. Cultivation here, as shown in Fig. 19, is considerably thinner than in the two former zones. This is due to a combination of both soil and rainfall factors. The soils of the region are much less deep and rich than those of the river valleys, and hence will not bear as heavy cropping. But it is rainfall which is the most weighty factor. This region lies in the rain shadow of the Western Ghats,and is one of low and uncertain rainfall. The ryot prefers to grow a hardy food crop like jowar, rather than risk his all on a commercial crop. Moreover, the heavy September rains in this region, which are the maximum falls of the year, are often very detrimental to the ripening cotton. Fig. 19 shows that the intensity of cultivation materially increases on approaching the south of the area, in northern Dharwar. This is again due to rainfall. The southern regions of the Bombay Deccan experience a heavier late rainfall than the more northerly ones in September and October, and this, though it prevents the growing of a kharif crop owing to the damage it does to the ripening bolls, yet permits of the growth of a very successful rabi crop.

The influence is well shown in the cotton types of the area. Those grown in the uncertain tracts are mainly inferior varieties of Oomras, generally less than half an inch in staple, coarse, but very hardy. Those of the southern part are a much superior variety known as Kumptas, an indigenous variety, but with a staple up to ⅞in. and a good strong fibre. It is one of the best of the indigenous Indian cottons. In this southern region of Bombay cotton cultivation continues from the regur soils on to the red soil regions of Dharwar. Here the cotton grown is no longer an Indian variety, but an American, known in commerce as Dharwar American. From the attempts to grow American cottons in India it has been proved that the black soils are entirely unsuited to them ; they are shallow rooted plants, and prefer the sandier red

1 Bull. Dept. Agric. Bombay. " Cotton in Bombay Presidency," 1906.

FIG. 20.

loams. The Sind American, Punjab American, the Cambodias of South Madras, and the Dharwar American cotton tracts, the only flourishing regions so far, are all light soil regions. The types grown in Dharwar are a mixture of upland Georgian and New Orleans mainly, which were introduced to the region in the mid nineteenth century. In spite of the successful growth of these types, the area has remained strictly limited, again mainly on rainfall

grounds. The crop being a light soil crop is sown at the end of the kharif season in August and September, if unirrigated. The kharif rains of Dharwar are considerably greater than in the Deccan tracts to the north and east of it,[1] on account of the break in the Ghat barrier to the west. The rainfall diminishes rapidly eastwards, and the region where the cotton will grow is thus limited. Irrigation also is more developed here than on the Deccan to the east, and deficiencies in the rainfall can thus be remedied. The question of maritime influence also is of interest. The finest varieties of American cotton are grown near the sea, notably the Sea Island; even the inland districts of the American Cotton belt receive winds blowing in from the Gulf of Mexico. It is interesting to note that the Dharwar region, owing to the break in the Ghats, receives maritime influences which the tracts to the north and south of it do not, and this may be a factor in the successful growth of American cotton in the area.

Dharwar American yields a staple only of $\frac{7}{8}$in. This is chiefly due to bad cultivation and mixing of types, which has caused deterioration of the original variety.

The last cotton growing district of the Peninsula for discussion is that of the regur lands of the Madras Deccan and South Western Hyderabad, The soils of South Western Hyderabad are poor and very mixed, and the rainfall very uncertain, hence the cropping of cotton is not heavy. On the black soils of the Madras Deccan, owing to the light kharif and heavy late season rains,[2] the crop is entirely rabi, and as such, is very important in the agriculture of the region. The cottons of both districts are short stapled. On the poorer soils in South Western Hyderabad and parts of Bellary and Anantapur, and the south east corner of Bijapur (Bombay Presidency) the cotton grown is termed Westerns; its staple is about $\frac{3}{4}$in. On the better soils of the Madras Deccan in Kurnool and Cuddapah, and the rich Nandyal valley to the East, the cotton has a longer staple about $\frac{7}{8}$in. and is termed Northerns. This, peculiarly, varies in colour according to the soils on which it is grown; where red soils are mixed with the black it has a reddish tinge which reduces its value.

In view of her very large production of cotton[3] and the fact that Lancashire is receiving decreasing quantities of long stapled American cotton each year, owing to the increased demand for raw cotton in the States, and the great losses incurred through the boll weevil, India assumes an importance in the Lancashire cotton market as a source of raw material for the future. At present her cottons are much below the length required in the Lancashire market,[4] and her export is mainly to Japan and the continent; much also is consumed in her own mills. An investigation was made in 1919 by the Indian Cotton Committee[5] to ascertain just how far India would be able to contribute to the Lancashire demand, and their final conclusion was "India cannot, for at least ten years grow cotton in any commercial quantity of a staple longer than $1\frac{1}{16}$ ins. The only tracts from which this may be expected in the near future, are those parts of Madras where Cambodia and Karunganni cotton are grown, and the Punjab, where American cotton is making rapid headway." Even though not suitable for the finer Lancashire mills, India will aid her own cotton industry by improving her indigenous varieties. This may be

1 See Rice Section, for rainfall variation in this region.
2 See Jowar.
3 1919-20. 4,800,000 bales of 400lbs. each (British Empire Cotton Growing Ass., 1923). 1917. 16.5 per cent. of world's supply.
4 Lancashire requires staples 1in.-2in.
5 See report Indian Cotton Committee, 1919.

done by more careful cultivation, and by selection of pure strains of good varieties which do exist among the indigenous Indian cottons. More care in the marketing and cleaning of the Indian cottons will also materially increase their market value; their degree of adulteration is notorious. India may also obtain a bigger income from her cotton crop by improving her yield per acre; this is only 85 lbs. as compared with 450 lbs. for Egypt, and 200 for U.S.A.

Such improvements of the indigenous cottons are assuming a vital significance in India, in that her cotton industry is aiming at spinning much finer yarns, the raw material for which the finer varieties of indigenous cottons might supply. That she once manufactured a much finer cotton is proved by the once famous Dacca muslins.

Oilseeds (Figs. 21, 22, 23).

The cultivation of oilseeds on the Deccan has a two-fold significance, in that they are grown both as native food crops, and as export crops.

As native food crops their value lies in the large proportion of protein they contain, which is about 30 per cent. in ground nut; also in their high proportion of fats, which is 45 to 50.[1] These fats are used by the native both for food, and for household purposes.

For commercial purposes the seeds are valued only for their oil, and the sole aim of the commercial grower is to raise a seed which will yield the highest percentage of oil. For this reason, particularly in relation to ground nut, introduced varieties yielding a higher percentage of oil than the indigenous nuts are now largely grown for commerce; the native still prefers his indigenous crop for home consumption, since the oil is much sweeter than that in the foreign varieties.

The growth of oilseeds on the Deccan is very extensive. *Ground Nut* cultivation, as shown by Fig. 21 is not confined to either the black soil or the red soil regions, since it will grow on almost any soil which is moderately fertile and not too heavy. It is a common crop in the loamy garden lands of the Western Deccan, or the fertile red soil valleys of the south and east; where the rainfall is below 40ins. it is often irrigated; but it will thrive as a dry crop in regions with as high as 70ins. rainfall. Its absence from the heavy soils is very noticeable, and arises from the peculiar growth of the plant. The nuts are formed beneath the ground at a depth of several inches, and, not only must the soil be light and friable in order to allow the fruit shoots to penetrate the soil, but, at harvesting time, it is most difficult to gather the crop from a heavy soil. The labour cost is at all times high, but it is prohibitive on such lands. The nuts also are dirty and discoloured after growing in a heavy soil, and this greatly reduces their market value. The heavy soil regions of the Deccan also have too low a rainfall, and have no irrigation facilities to compensate. The time of sowing has a very intimate relation to the rainfall, in that the crop must be sown so as to avoid heavy rainfall after the nuts are ripe; a shower on a ripened crop will make the nuts sprout, and the crop is ruined. The danger is enhanced by the fact that the crop, even with very heavy labour, takes some weeks to gather.

Ground nut cultivation on the Deccan is mainly in two regions, the Western Bombay Deccan and the red soil country of the Madras Deccan. In the latter the crop was first cultivated in a small way as an irrigated garden

1 Church "Food Grains of India."

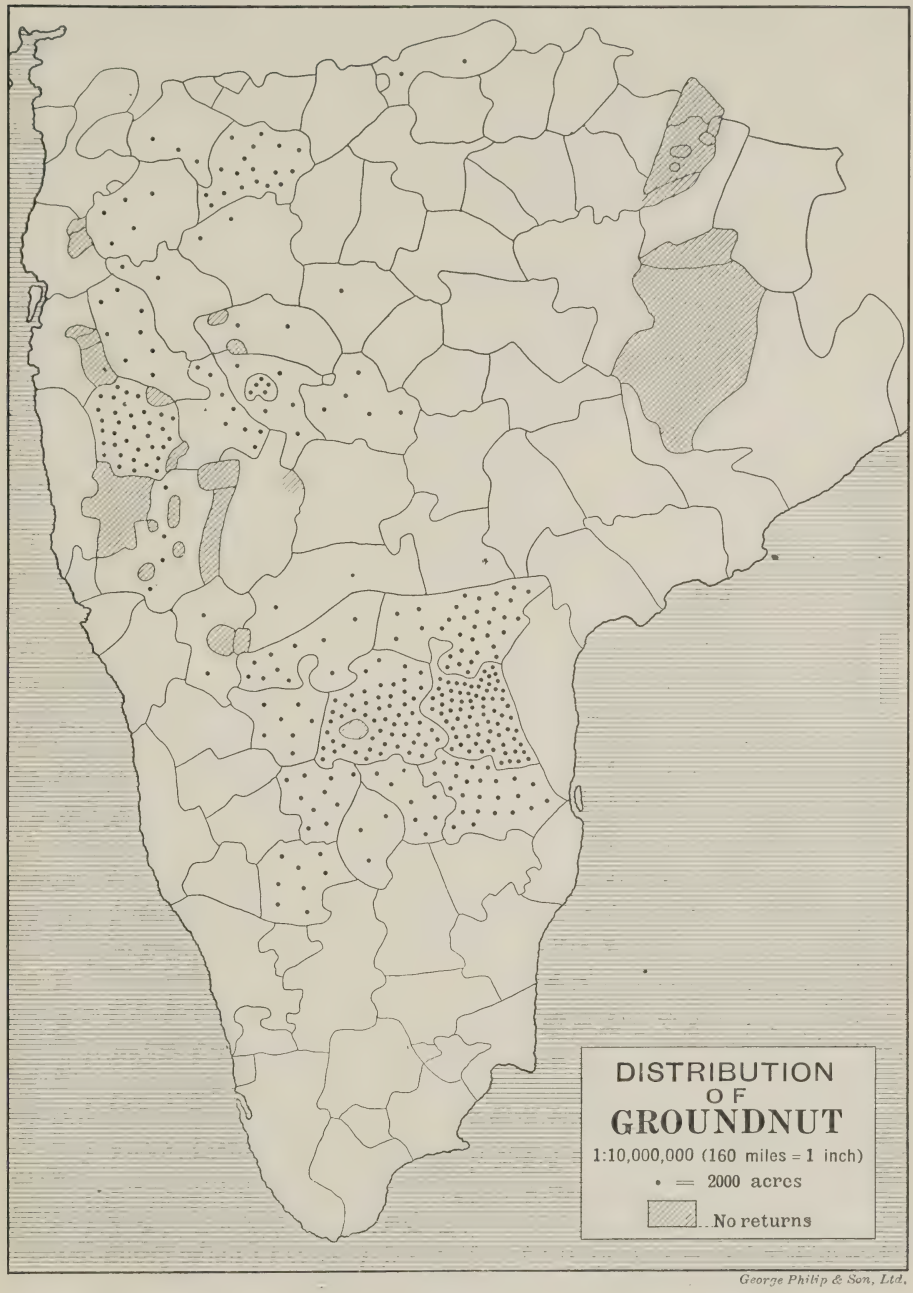


FIG. 21.

crop, but the rapid development of the groundnut trade has extended its cultivation on rich and poor lands alike—the red loams of the valleys, the river silts, and the poorer uplands soils. It is also grown on similar soils in the Maidan[1] districts of Mysore.

1 The " Maidan " of Mysore is the more level eastern and central part, as contrasted with the rugged western part—the " Malnad."

Rainfall factors in these regions determine the sowing season. In the Madras region the crop is sown at the beginning of the summer, and the rainfall gradually rises to a late summer maximum as the crop is flowering. It is at this time that it needs most rain. After flowering, the seed ripens with a diminishing rainfall, and the crop is harvested in dry weather after the rains are over : it is on the market by January or February. On the Mysore plateau, the spring rains permit of the crop being sown earlier, but, since the early crop takes longer to mature than the late one, both appear in the market at the same time ; this is reflected in the very low market prices ruling in January and February.

In the Bombay Deccan, groundnuts are grown principally on the lighter soils of the more certain rainfall tracts on the eastern slopes of the Ghats ; there is an extension of this area across the medium and light soils of Sholapur into Osmanabad and Bidar in Hyderabad. On the whole it is very little grown in the eastern parts of the Bombay Deccan on account of the heavy soils and scant rainfall. It is typically a crop of intensive garden cultivation in the western part, and reaches its maximum intensity in Satara, where normally 42.4 per cent. of the cropped area is under groundnut, grown in rotation with sugar cane, vegetables or irrigated wheat. Being a garden crop the area is naturally restricted, but the intensity of cultivation more than compensates for this ; in the Poona district an irrigated crop will yield 3,000 to 4,000 lbs. per acre ; the unirrigated crop yields only 1,000 to 1,600 lbs. per acre. The profit on an irrigated crop is calculated at about Rs. 30 per acre.

As in Madras the main varieties for export are foreign varieties, Spanish Peanut, Japanese, or Mauritius which yield a much higher percentage of oil than the indigenous varieties.[1] Further, they have great value in that they mature in $3\frac{1}{2}$ to $4\frac{1}{2}$ months, while the indigenous varieties take normally over six months. This would not be so vital, were it not that the groundnut crop is greatly afflicted with a disease termed " Tikka " which attacks and ruins the crop in close wet weather, and which has been one of the main factors in restricting groundnut cultivation. The introduced varieties are not immune from it, but being in the ground for a shorter time naturally run less risk than the indigenous crop. The quick ripening varieties of Bombay enter the market some six weeks before the Madras crop, and thus prevent prices from sinking below an economic level by too great a supply at once.

The absence of groundnut cultivation from both the eastern districts of Hyderabad and the western districts of Mysore, is most probably due to the very restricted areas of fertile soils in these regions, which are chiefly required for growing food crops. Hyderabad is as yet not a commercially cropped country, and her oil seed crop which is required for home consumption is one which will grow on the poorer lands and yield a good return, sesamum or til. It requires far less intensive cultivation than do groundnuts. Til cultivation is also a feature of the western districts of Mysore, where groundnut cultivation is absent. This too, is a region not commercially cropped save in the coffee districts, since it is too far from the export centres to make groundnuts a paying crop under the present transport conditions.

The greatest limiting factor in groundnut cultivation, however, apart from physical requirements, is expense. Commercially, it affords to the ryot

1 Spanish Peanut 47.73
Small Japanese 45.83
Mauritius 45.09
Indigenous 42.8

} It is calculated that 36-40lbs. of oil are obtained from 100 lbs. of seed of the Introduced types. Sampson—Dept. Agriculture Madras Bull.

See " Groundnuts in Bombay Deccan." Bull. No. 41, Bombay Dept. Agric.

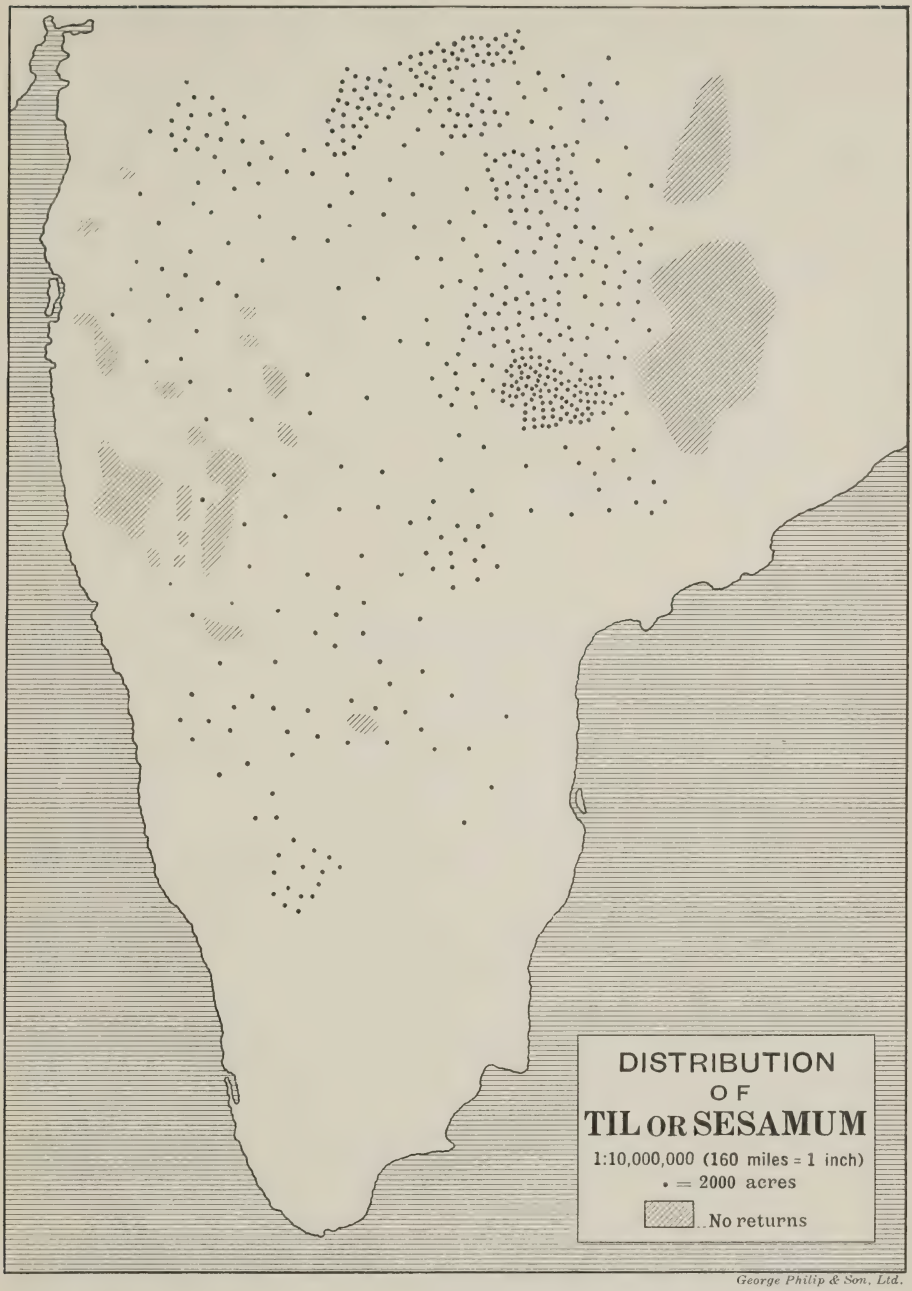


FIG. 22.

a very paying crop, if he is prepared to make a big outlay. The root of this expense lies in the labour required. Throughout the growing season the crop must be hand weeded lest the fruit stalks are choked, and the top soil must be constantly loosened with a hand hoe, so that the shoots may penetrate the soil easily, and the nuts may form properly beneath the soil. All this requires much labour. The biggest call on the labour supply, however, is at harvesting

time. The soil has first to be loosened by hand, round the plant, so as not to damage the nuts ; then the nuts have to be picked out of the soil, where they are often 3ins.-6ins. below the surface. A heavy surface soil naturally increases the labour. Normally about fifteen diggers and seventy-five pickers are required per acre. It is not so much this which raises the labour difficulty, but, the fact that, should a fall of rain occur after ripening, the nuts sprout, and the crop is spoilt. The aim of every farmer is to garner his crop with the greatest possible speed and diminish the risks. When the cultivation of the crop is small he has little difficulty in doing so, but when, as in the districts studied, hundreds of acres are cultivated in each small district, the competition for labour is keen, and wages are forced up, with the final result that out of about a total cost per acre of Rs. 80 for growing the crop, labour costs at least Rs. 30. Thus it comes about that " Scarcity[1] of labour is one of the serious drawbacks to the present system of groundnut cultivation, and will always be so,especially in the dry red soil tracts which will not support a large population." Given a good labour supply, a fertile soil, and careful cultivation, the crop is very profitable, giving an income of about Rs. 18 on dry land, and Rs. 32 on wet land. Moreover, it is a crop which can practically always find a market ; when it cannot, it can always be used as a food, and thus has an advantage over cotton.

Linseed (Fig. 23).

Linseed is typically the crop of the heavier soils of the Deccan, as groundnut is typical of the loamy lands. The crop is grown on the Deccan not for its fibre but for its seed. The fibre crop requires a light sandy soil, and a long cool moist vegetative period, which latter is impossible on the Deccan. The crop on the plateau has an identical distribution to wheat with which it is grown in rotation as a rabi crop. The fact that it is always a rabi crop explains its growth on the heavy retentive soils. It can not be grown during the kharif season, since the rains cause a rust disease which ruins the seeds. As with wheat, a belt of dense cultivation extends along the Tapti valley, the plains of Berar and Nagpur, and is continued eastwards over the fertile loam lands of the Wainganga valley. Here the heavier rainfall compensates for the less heavy soils ; it is extensively grown here as a second crop after rice. A second belt of dense cultivation is apparent along the rich soils of the Godaveri valley, though here the zone is narrow as compared with the northerly one. A third region of cultivation is the black soil plain of the eastern Bombay Deccan, where the heavier September rains compensate, in a measure, for the less retentive soils. Even with this greater late season rainfall, cropping is not nearly so heavy as in the river valley soils to the north. Linseed is entirely absent from the rest of the Deccan, owing to the unsuitable soil conditions. On the black soil region of the Madras Deccan it could be grown as a rabi crop, but since there is only one cropping on these lands owing to rainfall, it is ousted by jowar and cotton.

Numerous other oil seeds are grown on the Deccan, some for home consumption, and some for export, such as safflower, niger seed, and castor seed, but linseed, groundnut, and til have been discussed, primarily because they are the most important of the oil seed crops of the Deccan, and further, that they present a remarkably complementary distribution. Linseed is the crop of the heavy black and brown soils, groundnut the crop of the light black and the loamy red soils, while til is the crop of the poorer red and black soils. A composite map of these three oil seeds would show that every part of the plateau has its oil seed crop.

1 Cultivation of Groundnuts in Madras. Sampson, 1899.

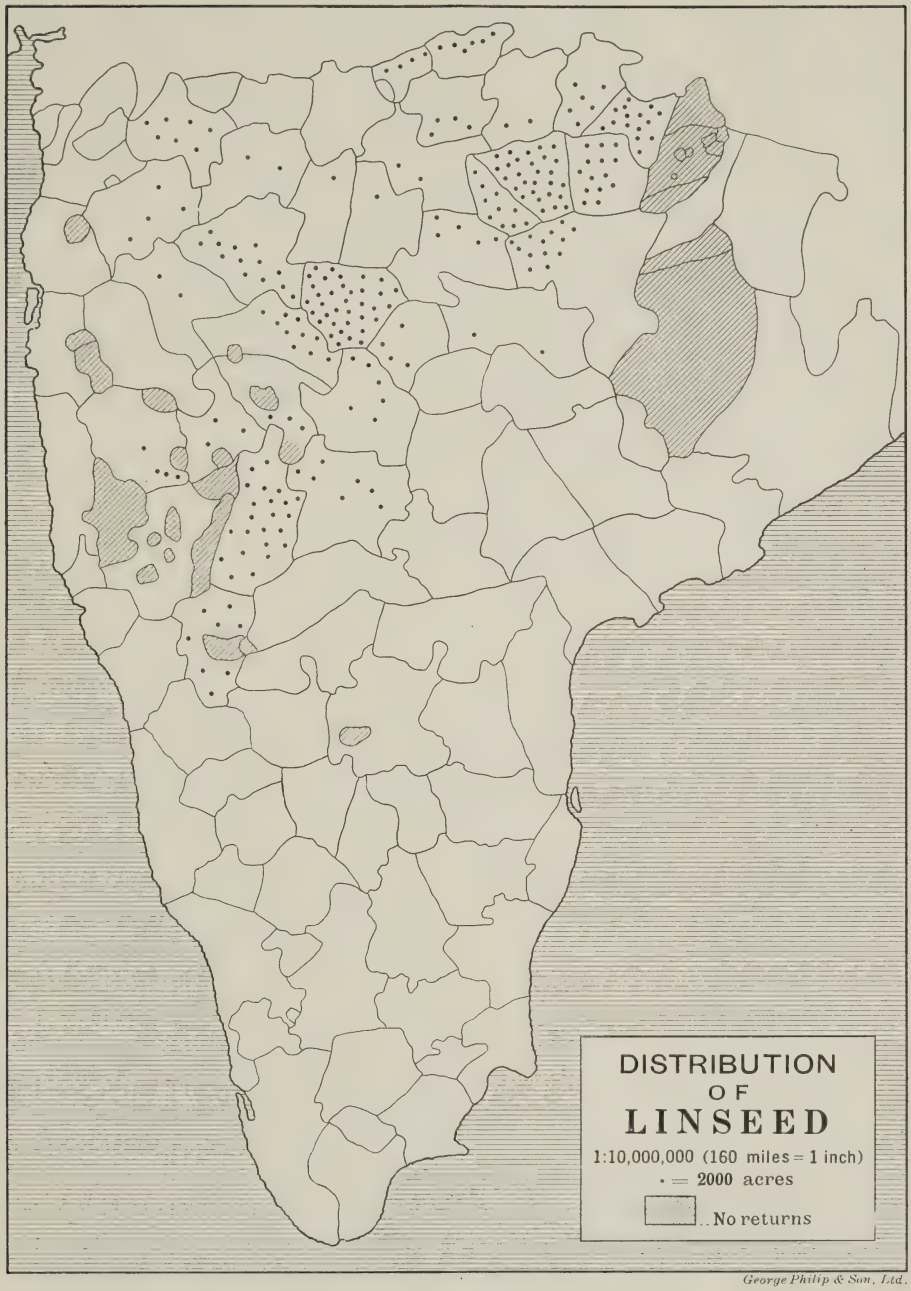


FIG. 23.

Sugar Cane and Garden Cultivation.

Sugar cane growing is typical of the most intensive cultivation which the Deccan ryot pursues, and one which causes him great expense in two commodities very difficult to procure on the Deccan, water and manure.

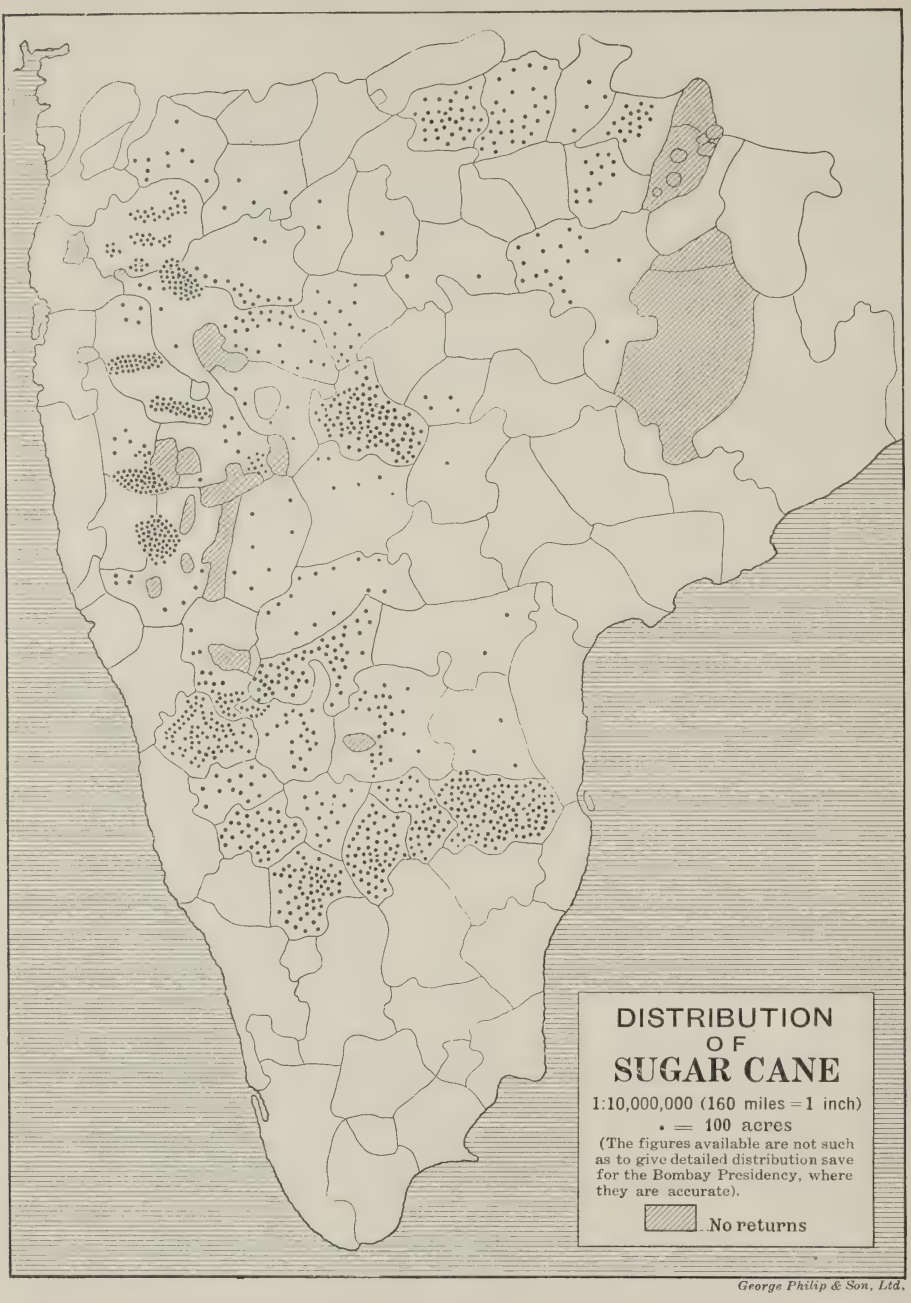


FIG. 24.

Sugar cane is essentially a crop of hot wet climates and rich soil. It requires about a year's growth for maturity, during which time it requires constant watering, hence the limitations to its growth on the Deccan are strict. It is confined to those regions where an assured supply of water is available, and the distribution map shows clearly the relation between irrigation and sugar cane growth. It is only sparsely cultivated in the regur

regions under well irrigation, but follows the irrigated valleys throughout the red soil areas, where it is grown in association with rice. Patches of very dense cultivation are mapped along the rugged lands of the Western Bombay Deccan in Nasik, Ahmednagar, Poona, Satara, and Belgaum. These very dense patches mark the great canal systems, where irrigation is perennial, fed from the heavy rainfall tracts of the Western Ghats. A typical example is the Nira canal of the Poona district. Sugar cane cultivation in the Bombay Presidency, though surpassed in acreage by the cane growing districts of Upper India, gives a higher yield per acre than the latter, since the system of growth is so intensive. A normal yield is 7,000 to 15,000 lbs. of gul per acre. The intensive nature may be gathered from the following brief account of cultivation in the Poona district. The cane is sown in heavily manured beds in January, and requires watering every four days during the hot season. During the monsoon, the crop is watered only if there are long breaks in the rains. After the monsoon it requires water every eight days till maturity. The total rainfall of the year for Poona is 29.34ins. and in addition to this the cane gets irrigation water equal to 75ins. to 80ins.of rain. The expense of irrigation is high, but it is estimated that in the Poona district it yields a profit of Rs. 150 per acre, and pays a large part of the irrigation revenue on canals.[1] Other extensive areas of cultivation are found in the fertile Wainganga valley, and the rich red soil valleys of Hyderabad, Madras and Mysore. In all these areas it is grown associated with such crops as chillies and vegetables, which are grown very intensively, and on a small scale, hence the term " Garden cultivation."

Coffee (Fig. 25).

Coffee is not indigenous to South India. It is believed to have been brought there in the late eighteenth and early nineteenth centuries, and its cultivation being successful, plantations were started, the first at Chickmagalur in 1830, and later on the Shevaroys, Wynaad, Nilgiris and Palni hills.

Coffee cultivation cannot be termed typical Deccan production ; it is an overlap from the warmer wetter hill regions of the South. The factors governing its distribution are particularly interesting and forceful, in that they limit its growth to so small an area. Its requirements are numerous, involving soil, rainfall, elevation, drainage and shade.

The soil required is a rich sandy loam, (not necessarily deep, since coffee is a shallow rooted plant, and draws its nourishment from the upper layers of the soil) which is well supplied with humus. The latter is essential since the coffee plant requires a great deal of nitrogen. A further requirement is lime. This is very deficient in the coffee soils, being only ·5 per cent., while at least 1 per cent. is required, and so it must be supplied artificially. Lime makes the soil friable ; it also counteracts any acidity in the soil, which is very liable to occur, if much humus is present ; further, it assists in the decomposition of the humus, and renders the potash in the soil more available to the plant.[2] Coffee flourishes best at an altitude of 1,500 to 5,500 feet on a sloping well drained surface ; so important is the latter that the ground is often drained artificially with pipes and channels.

At heights of 1,500 to 5,500 feet one does not expect to find a rich loam, particularly on a sloping surface in a region of heavy rainfall, but the presence of heavy forests make this possible, since they check erosion and permit of a good soil being formed, which is further enriched by their humus. The humus

1 Watt. Commercial Products of India.
2 Anstead. Coffee Cultivation in South India. Bull. Dept. Agriculture Mysore.

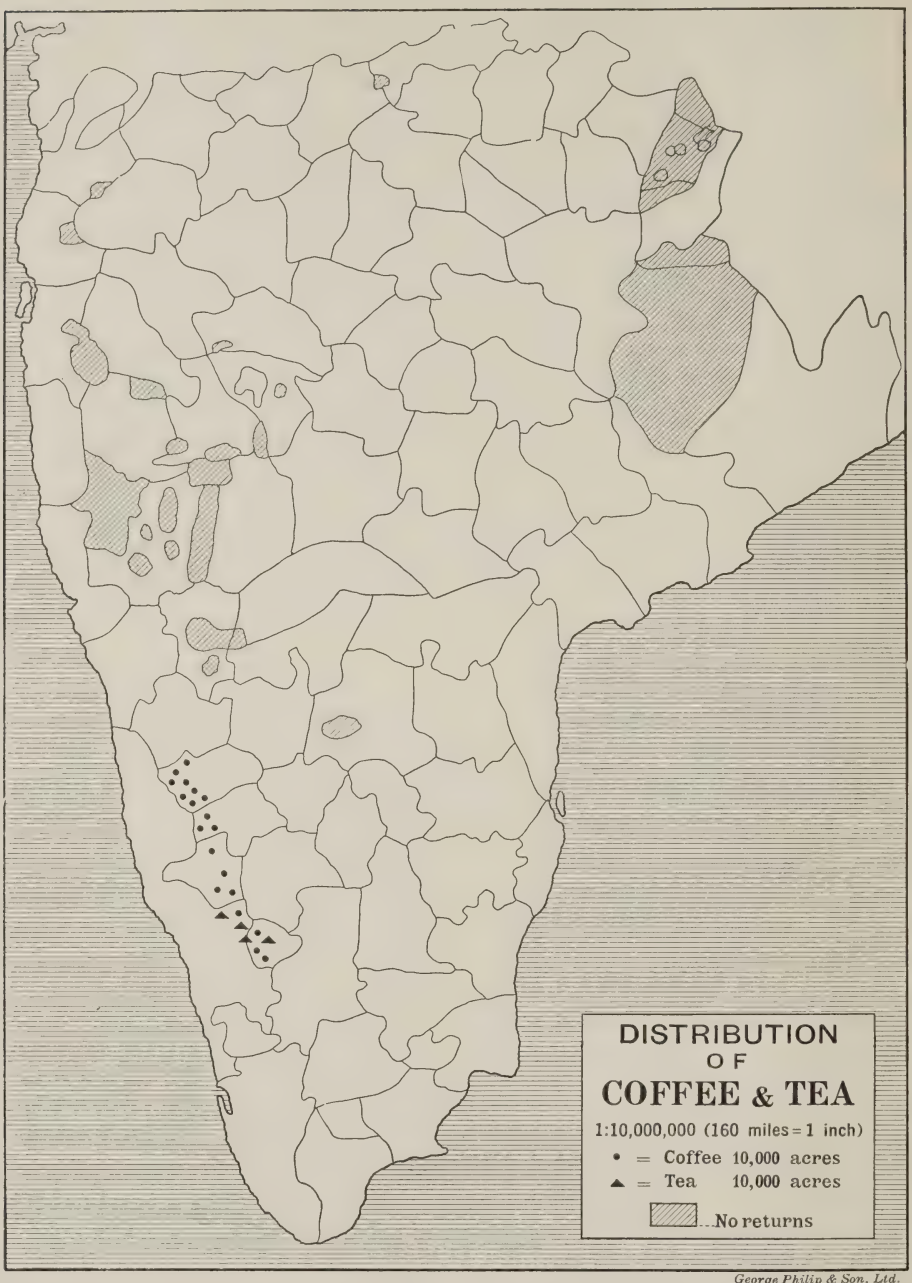


FIG. 25.

covering is a big factor in keeping the soils in position, and is often further assisted by the growth of a cover crop.[1] The keeping of the soil in position is very vital in coffee growing, since it is a shallow rooted plant.

1 " Renovation " pits are often constructed into which the soil is washed by erosion, and preserved.

The coffee soils are either rich red loams, or lateritic soils brought down from the laterite cappings of the Ghat crests. Some of the ferruginous red loams are often taken for laterite, being very similar to it. The combination of the rich red soils and the humus gives an admirable coffee soil.

From the above requirements it might seem that the whole slope of the Western Ghats might be suitable for coffee cultivation, yet it is restricted to a very small area in the western parts of Kadur, Hassan and Mysore, Coorg, and the Nilgiris and Wynaad. The limiting factor is not rainfall amount, but rainfall distribution. Coffee requires a rainfall almost throughout its growing season, and the well distributed rainfall of Western Mysore, fulfils this requirement, where the one season rainfall of the more northerly regions does not. Of all the rainfall periods the most determining is the spring fall, known in Mysore as the " coffee " or " blossom " showers. Coffee flowers in April and May, and the fruit is necessarily dependent on good flowering ;[1] this is dependent on the amount of the spring falls. If the spring rains are deficient, then the blossom shrivels and the fruiting is poor. Five or six inches of rain are necessary in the months of April and May, and they very definitely limit the northern growth of coffee. A quotation by Anstead of the Mysore Agricultural Department shows the significance of these spring rains. " The climatic conditions at this time of the year have a great influence on the coffee crop, and since these conditions cannot be controlled, the zone in which coffee will grow is necessarily limited."

Since coffee requires moisture throughout most of the growing season, and moisture in the top layers of the soil, as it is a shallow rooted plant,[2] also very great heat which reaches 80°-90° in the hot season, some method must be adopted to prevent the intense evaporation which would take place under such conditions. The remedy is shade. Good shade trees have several attributes ; they must be deep rooted, so as not to take nourishment from the layers in which coffee feeds, they must not shed their leaves in the hot season when shade is most required, they must have a good spread of branch, and yet not grow too big. The shade tree most preferred in this coffee region is silver oak. Not only do these shade trees conserve the moisture, but, by drawing water from deep down in the soil, and giving it off in transpiration, they tend to keep the air moist around them, and so reduce the temperatures. A second vital factor in shade regulation is its relation to the greatest of all coffee pests in this region, the coffee borer. This pest has made untold ravages among the coffee plantations of South India, and it has been shown that the prevalence of coffee borer is in a large measure due to bad shade regulation. It cannot flourish where temperatures are low and moisture plentiful, but it appears rapidly when shade is bad and the hot sun dries the air. Thus, the regulation of shade is one of the keenest points to a coffee cultivator, since he must study it in relation to the aspect of his own particular plantation ; no general rule can be laid down.

The experimental stations in these regions are devoting their attention to the production of strains of coffee which will resist the coffee borer, and which will compete favourably in size, colour, scent, and flavour, with the Brazilian varieties, which have affected the Indian crop seriously. It is to the coffee borer, and to the competition of cheap Brazilian coffee that many of the disasters of coffee growing in South India are due.

Tea cultivation is now extending in South India, mainly on account of the decreases in the coffee areas, but it is North India and not South India that

1 See rainfall curve for Hassan.
2 The tap root of coffee serves only to fix it in the soil—the feeders are at the surface.

is the real domain of the tea plant.

Tea requires a light loamy well drained soil, with a sufficiency of plant food, hence the coffee soils suit it admirably. It varies in its climatic requirements. It is grown on the hilly colder districts of Darjeeling, on the temperate Nilgiris, and in the hotter drier parts of Lower Assam, but its general requirement is a sub-tropical climate with temperature 75°to 85°F.,and rainfall 60ins. to 100ins., which is well distributed. Thus the coffee regions are eminently suited to it, and cultivation is extending in the Wynaad and Nilgiris.

Cinchona is also a plantation crop typical of the coffee regions. It was introduced to the Nilgiris and Wynaad in 1869, and there are now several plantations. It is grown further west than coffee since its rainfall requirements are not so great, and it flourishes up to 3,000 feet. Its soil requirements are very similar to coffee.

The importance of a good quinine supply in a land like India, where fever is so prevalent, cannot be over-estimated. Prior to the growth of cinchona in India, the drug was imported from Java, and was, therefore, highly priced. The importance of its cultivation in India, therefore, lies in the fact that it provides a very valuable drug, in a region where it is badly needed, at a cheap rate. It costs now less per pound than it did per ounce prior to its introduction into India, and supplies are so organised that it can be obtained at the post offices throughout the land, at the cost of about one farthing per dose. " This valuable medicine has been brought to the very door of the poorest peasant of India, and it is no wonder that the recurrent vital statistics mark year by year the conquest of India's most vital scourge."[1]

II.—PRODUCTION REGIONS OF DECCAN.

A survey of crop distribution on the Deccan shows that it falls into several well marked regions of production. It is proposed to term the crops which grow in these regions of production " production associations " since it is the growing association which forms the production region.

Plants grow in association either because they require similar conditions for growth, or because they are supplementary to each other, having different requirements. Since these requirements are dependent for their satisfaction on the region in which the plant grows, the associations are necessarily dependent on the physical factors operating in the region.

These production associations are the central theme of this study, in that they interpret the soil and climatic factors in the region, and on this interpretation is based the life of the land. The combination of the human factors with the production associations gives the real basis of Deccan life—the Rural Economy. It is proposed in this section to treat only of the production regions and not their effects. These will be discussed in a later section when the evolution of the human geography of the region has been briefly traced.

Surveying all the production regions, one striking fact is apparent. There are many production associations, but in every one (save the coffee-tea association which is not typically a Deccan type) either jowar, bajri or rice finds a place. Jowar and rice are the two great food grains of the Deccan, jowar being the staple where rice will not grow, and rice where jowar will not,

1 Watt. The Commercial Products of India.

thus, the first main production division may be based on those crops associated with jowar, and those associated with rice. The significance of this basic division is that it truly reflects the main function of cultivation on the Deccan, the feeding of its native population.

A.—THE JOWAR BAJRI ZONE.

This term applies to the region in which jowar forms a part of all the production associations. Jowar is the staple food grain in the heavy black soil regions where the rainfall is from 20ins. to 40 ins. Its distribution has already been surveyed and the main points for study in the jowar zone, are the minor associations within it.

Jowar, Cotton, Wheat, Linseed, Pulse Association.

This big association comprises the richest lands of the jowar zone. The association is grown as jowar and cotton in rotation during the kharif season, and wheat and linseed in rotation during the rabi season ; pulse is grown at both, mainly, as a mixture crop. It occupies the richest lands because the rabi crops can be raised only where the soils are deep and retentive of the late season rains. Jowar holds a prominent place in the association, not because it requires the richest lands and the best rainfall conditions, but because it is the only native food grain of the group, save the pulse.

The association is found in its most perfect form in the Tapti valley, the plains of Berar and Nagpur, and the Wharda valley, since here the soils are rich and deep, and the rainfall more certain than to the south. The zone is terminated to the east by the replacement of the regur soils by sandier red soils. A second, though not so extensive a belt of this association lies along the Godaveri valley to the south of the Ajanta Range. The richest soils are restricted to a narrow belt along the river valley, and the production region follows these soils, widening on the plain of Kopergaon in western Nasik. and the plain of Parbhani in northern Hyderabad, where the valley widens, A third belt of this association occurs on the plains of Sholapur Bijapur, western Belgaum and north eastern Dharwar (Bombay Deccan). This region does not exhibit the association as perfectly as to the north. The soils are much less deep and retentive, but throughout are black cotton soil, eminently suited to the growth of cotton or jowar through the kharif season. The rabi growth of wheat and linseed is harder to understand until the rainfall conditions have been analysed. The " raison d'etre " for rabi wheat and linseed in the first two zones of this production type, is the great retentive power of the deep soils. The less deep soils of the latter zone are not so retentive, but, this is compensated for by the fact that it experiences much heavier late rains than do the regions to the north, which make rabi cropping very successful, sometimes more so than the kharif. Throughout this area cropping is much less intensive than in the two northerly zones, not only on account of the lesser soil fertility, but also because of the very uncertain character of the rainfall, the region lying in the rain shadow of the Western Ghats.

Jowar, Cotton, Bajri, Oilseed, Pulse.

Where, in the regur lands, the soils are not good enough for rabi wheat or linseed, and the rainfall does not compensate for soil deficiency the association found is *Jowar, Cotton, Bajri, Oilseeds and Pulses.* This association is typical of the medium black soils between the Godaveri and Tapti valleys, north and south of the Ajanta Range, in southern Khandesh and Berar, and north west Hyderabad, also those soils south of the Godaveri valley and north of the Hyderabad ranges. The late rains do not remedy

the lesser retentivity of the soil, and wheat and linseed are only sparingly grown. Jowar and cotton are grown either as kharif or rabi crops, since they do not require so much moisture in the rabi season as wheat or linseed. Bajri is always grown as a kharif crop on the poorer soils of the region, while pulses and oilseeds are grown throughout as mixed crops. A further belt of the association is found in south west Hyderabad, in Raichur and Lingsugar. Here the soils are very poor sandy or mixed black, and even the heavy late rainfall does not compensate for the lack of soil retentivity. Thus the main crops are kharif, with rabi crops only on the richer patches of soil which occur. This region, being one of sandy soils might be expected to come within the rice region ; this is not possible since it is one of the driest and most uncertain rainfall tracts of the whole of the plateau; rice could not be grown without irrigation, which is almost absent in the region.

This same production association is found on the regur plains of the Madras Deccan in Bellary, Kurnool and Cuddapah, where the soils are only moderately fertile, and in the Nandyal valley to the east, where the soils are richer. In the western parts no kharif crops can be grown on the regur, since this region is not only one of the hottest parts of the peninsula in spring, but is the centre of low and uncertain rainfall. The soils are so hard baked in the hot season that the scanty rains of the kharif season are not sufficient to render them fit for cultivation. The principal crops sown are, therefore, rabi, dependent on the late season rains, the maximum falls of the year. In the Nandyal valley the kharif rain is low also, and the main rains occur in September and October. Jowar and cotton are grown as rabi crops on the heavy lands, and groundnut on the more loamy lands. Wheat is not grown, partly owing to the short growing period, and partly to the fact that the heavy rabi lands are required for cotton and jowar.

Bajri, Pulse, Sugar Cane, Groundnut Garden zone.

This association is found in many parts within the jowar zone. It characterises the regions with soil not heavy enough for jowar, and rainfall not heavy enough for rice. A sub-region of this association is the bajri pulse zone, which is found on the poorest soils, and the most uncertain rainfall tracts of the jowar zone. This latter is charcteristic of the east-west spurs of the western Ghats, and parts of the Satpuras.

The main production association characterises the zone of heavy and certain rainfall on the leeward slopes of the western Ghats, which has as its eastern boundary a line running north and south a little to the east of Poona. Not only has the region a good rainfall, but irrigation is much developed and it thus has a big advantage over the more easterly parts of the Bombay Deccan. The region is one of garden cultivation par excellence ; the gardens are found in the rich valleys, and under well irrigation and heavy manuring, produce large crops of vegetables, groundnuts and fruit. These smiling gardens which show intensive cultivation at its height, are a great contrast to the poorer millet and pulse cropped slopes.

This intensive cultivation finds its greatest development round the big towns like Poona where the demand for fruit and vegetables is great, and a good supply of manure is obtainable. The development of great irrigation schemes along the slopes of the Western Ghats has also fostered this type of cultivation. The map of sugar cane distribution (Fig. 24), which is a typical garden crop, shows the concentration on the irrigation canals of the Western Deccan.

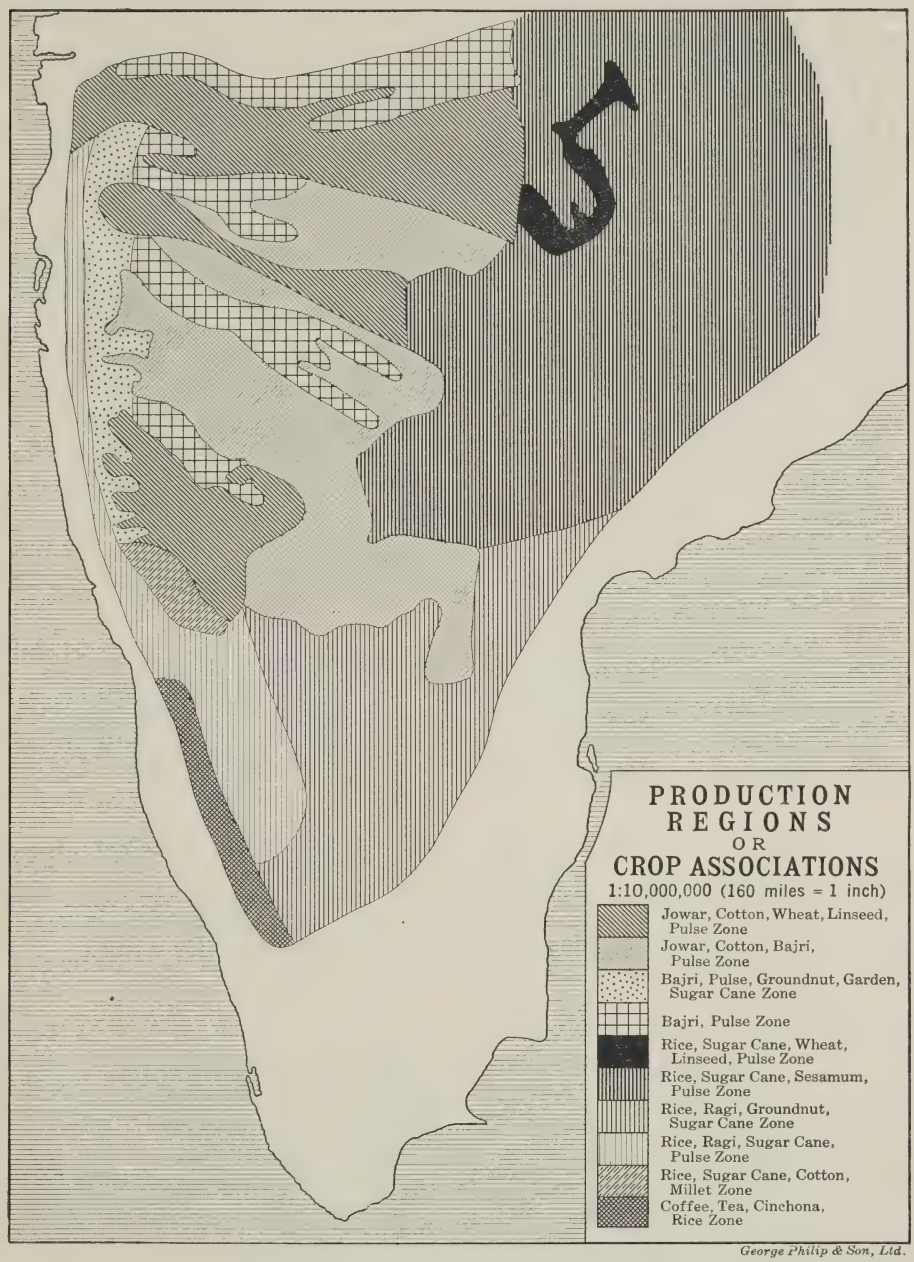


FIG. 26.

The regur lands do not lend themselves to garden cultivation. The soils are not suited to irrigation, even if it were possible, and garden cultivation is too expensive a form of agriculture to risk in regions of precarious and low rainfall.

B.—RICE ZONE.

Proceeding up the Western Ghat slopes from the bajri zone, we merge into a production association characteristic not of the jowar zone, but of the rice zone. The *raison d'etre* for this is rainfall. Rice is grown in many of the gardens of the Western Ghats, but under irrigation and not extensively. In this region which is limited on the east by about the 50ins. isohyet, and on the west continues right up the Ghat slopes, rice is grown on the red loams and lateritic soils without irrigation, as a result of the heavier rainfall. Ragi and other millets and pulses are grown on the poorer soils of this north-south strip, which links up with the Mysore plateau,part of the true rice zone, in the south. The sequence from the jowar zone to the rice zone is typified in this western region of the Bombay Deccan as it is nowhere else on the plateau, and it symbolises all the principles underlying the main production division. At the foot of the Ghats, in the flat heavy soil country, with precarious and low rainfall is the realm of the jowar millet and its associated crops. As the better soils are left behind on ascending the rugged slopes of the Ghats, bajri and other light soil crops replace jowar. Still higher, as the rising rainfall compensates for the lighter soil, we enter the rice domain. Precisely the same transition is observed on passing to the eastward of the jowar zone. The red soils replace the regur soils, and the rising rainfall permits of rice growing, at first under irrigation, and finally, in the heavier rainfall districts of the Godaveri and Mahanadi basins, without irrigation. The transition on the eastern side is, however, far more complex, irregular and prolonged, than on the western side, where the transition is rapid and clearly defined.

The Rice zone is thus characteristic of the red soil areas of the peninsu a with a heavier and more certain rainfall than the jowar zone,and with facilities for irrigation, which are supplied both by the rainfall, and by the topography of the country. Irrigation in these regions is mainly by tanks and the irrigation map (Fig. 9) shows that these rice areas are far more heavily irrigated than the regur lands.

Rice is similar to jowar, in that it occupies the better soils of the region in which it grows, while it is supplemented by millets and pulses in those regions where the soils are lighter. Jowar is not altogether absent from the rice zone. In the drier parts, on heavier soils, it is grown under irrigation but it nowhere approaches to the importance of rice, nor is it very extensively grown in these regions.

Rice, Sugar Cane, Wheat, Linseed.

The associations of which rice forms a part vary considerably with rainfall and soil conditions. To the north, in the region comprising the Wainganga Valley in Bhandara, Balaghat, Chanda, and eastern Nagpur, where the soils are rich brown or yellow loams, and the rainfall is from 40ins. to 50ins., in the kharif season, is the association of *rice, sugar cane, wheat and linseed.* Rice and sugar cane are the typical " wet crops," rice only being rarely grown as a dry crop here. As a wet crop its cultivation is intensive, not only from the fact that the soils and rainfall are good, but because tank irrigation is much developed in the area. (See Fig. 9). Often two or three crops can be grown in one year if the water supply permits. Added to this the acreage is large, since the Wainganga valley is wide, and the rich soil extensive. Wheat and linseed are typical rabi crops on the heavy black or brown alluvial soils along the river, and, though not as heavy as regur, the heavier rain compensates for the lighter soil. The region is not part of the richest wheat and linseed lands of the Central Provinces, being primarily rice land, but nevertheless the growth of wheat and linseed is important. Linseed is extensively grown as a second crop after rice.

Rice, Sugar Cane, Millets, Pulse.

To the south of the Wainganga valley, in north eastern and eastern Hyderabad and the lower Godaveri valley, the production association differs being rice, sugar cane, millets and pulses. This arises from two facts ; first, that the soils are poorer than in the former region, and secondly that the rainfall is less.

The rugged nature of eastern Hyderabad permits of rich soils only in the valleys. The Lower Godaveri valley, and the Pranhita River its continuation, which form the lowlands of eastern Hyderabad and the southern part of the Central Provinces, are regions of very poor soils, owing to the outcrop, right up the river, from the plateau edge to the junction of the Wharda and Penganga, of the Gondwana series of rocks (Fig. 1), which yield a very sandy, gravelly weathering. Thus the main river valley of the area contributes little to its agricultural wealth. The southern boundary of the region, the Kistna valley, has also only moderately fertile soils owing to an outcrop of the Cuddapah series of the Purana rocks, from its junction with the Tungabhadra to the plateau edge. This also yields a poor weathered product. Thus the region is not a rich agricultural area. Throughout, rice is the principal crop grown under tank irrigation. The rainfall is less than in the Wainganga valley the amount being from 30ins. to 40ins., and this far more reliable than in the more westerly regions. Since the soils are so restricted, the region is one of intense cultivation of the garden land type, rice, sugar cane and maize being grown, while millets and pulses are found on the poorer soils of the valley slopes. A feature of this zone is the extensive growth of the oil seed sesamum or til, which is almost entirely grown for home consumption. This oil seed can grow on much poorer soils than either linseed or groundnut, and is a hardier crop than either. It is also much less a commercial crop than either, which fact probably accounts for its growth in this region of Eastern Hyderabad which is very little developed commercially, in lieu of groundnut, which could be grown on the richer soils. Sesamum is distinctly a native oil seed crop, as compared with the commercial crop of groundnut.

Rice, Sugar Cane, Groundnuts, Ragi, Pulse.

To the South of this zone the production association is characterised by *Rice, Sugar Cane, Groundnuts, Ragi and Pulses.* This region comprises the eastern hilly lands of the Madras Deccan, and the Maidan or more level eastern and central parts of the Mysore plateau. It is characterised by the predominance of late season rains, but it has also an early summer rain, or, in the case of the Mysore plateau, a spring rainfall. The annual fall is much higher than on the Madras Deccan, ranging from 25ins. to 35ins. The soils are fertile red loams in the valleys, and poorer soils on the uplands. In this region, mainly under tank irrigation, rice and sugar cane are grown in the valleys, with groundnut on the better drained sloping lands where the soil is rich. On the upland slopes ragi and other millets, and pulses are grown. The well distributed rainfall in the Mysore part of the region makes it one of several croppings, instead of the kharif and rabi of the rest of the Deccan. Owing to the early spring rains the first crop can be sown in May, a second crop in July or August, and a third in October. Under irrigation a fourth crop can be grown in the hot season if the water supply holds out, and the spring rains are heavy. This region is also one typical of garden cultivation, particularly round the big centres of Bangalore, Kolar, or Mysore, where fruits and vegetable are much in demand.

Rice, Sugar Cane, Ragi, Pulse.

In the west of the Mysore plateau a production association is mapped not widely different from that to the east, *Rice, Sugar Cane, Ragi and Pulses*; the distinction is the absence of groundnut. This is due to the very

rugged nature of the land, which makes very scarce and precious the richer soils such as groundnut requires, and the land is chiefly devoted to food crops of rice or sugar cane, and garden products. Rainfall conditions here are particularly favourable for such irrigated crops since they have a heavier rainfall than the more easterly parts of the plateau, and are more heavily irrigated (Fig. 9). The low population density in these regions, and their great distance from the regions of export, also contribute to exclude groundnut from the area. It is essentially a cheap labour crop, and further, unless transport facilities are very good, it does not pay to send a bulky crop such long distances for export. Ragi is the staple millet of the uplands as it was in the eastern zone.

Cotton, Rice, Sugar Cane, Millets.

A minor association of the rice zone for discussion is the small tract of southern and western Dharwar and southern Bellary in which the crops are *Cotton, Rice, Sugar Cane and Millets.* The prime factor in this region is cotton. The soils are red fertile loams, and it is on these that the Dharwar American cotton is grown, being sown late in the kharif season in August or September. Its extent is limited by rainfall factors. The Dharwar region is situated opposite to a considerable break in the Ghats, and this appreciably increases the rainfall from the south west monsoon ; this, however, decreases rapidly eastwards so that the crop is confined to the more westerly regions. It is suggested also that the influence of proximity to the sea may account for the success of American cotton in this region. A further limiting factor is the native population itself. In many parts where soil and rainfall conditions are suitable, the cultivator cannot be persuaded to risk the growing of cotton, which might be much more profitable than his poor millet crops. Rice and sugar cane are grown as irrigated crops in the valleys, either as kharif, rabi, or hot season. Rainfall is good, and tank irrigation possible owing to topography, hence the region is very similar to the Mysore plateau to the south, with the exception of its cotton growing.

C.—COFFEE ZONE.

The final production region to be discussed, that of the *coffee, tea, cinchona and rice* association, is an exotic on the Deccan, an extension of a zone endowed by nature far more richly than is the Deccan, to the south of which it lies. The zone on the plateau is restricted to the western slopes of the Western Ghats, with a rainfall 70ins. to 150ins., of which 5ins. to 7ins. is received in April and May. Chickmagalur as typical has in April 2.23 ins., in May 4.86ins. This spring rainfall is the limiting factor northwards. It is on these falls that the flowering of the coffee crop depends, and, on the flowering depends the fruiting. The soils in the region are rich red or lateritic loams, with humus from the forests, among which the plantations lie. The shade required for coffee and tea growth is easily available in this naturally forested region. The great interest attached to this association, which comprises a narrow strip of the Ghats in Kadur, Hassan, Mysore, and the Nilgiris, is the system of production with which it is associated, and which, like the crops produced, is an exotic on the Deccan.[1]

A comparison and contrast of the two main production regions, that characterised by jowar, and that characterised by rice, is interesting. In the jowar zone are rolling, fertile and extensive plains, the soils of which, by their great retentivity, compensate in a large measure for deficiency of rainfall. Irrigation is not a big factor in the region, hence it is one typically of " dry cultivation," not only that, but of dry cultivation on a large scale. The vast

1 This will be discussed in the Rural Economy Section.

level plains are devoted to thousands of acres of jowar, cotton, wheat or linseed, and the aim in improving cultivation in the region is not to make it more extensive but more intensive.

In the rice zone an entirely different set of conditions operate. Instead of wide unbroken plains of rich soil, we find a land of barren hill tops and smiling valleys. No longer is there extensive dry cultivation of one dominant food crop which is the food of rich and poor alike. Food crops in this region are grown both " wet " and " dry." This is a land of tanks ; hardly a village is without its tank, great or small, and, as a result, the principal food crop, rice, is no longer one of extensive acreage, but of small irrigated tracts of intense cultivation. Naturally, this type of cultivation is more expensive than for a dry crop like jowar, hence rice is no longer as jowar is, the food of rich and poor alike ; it is the food of the better classes, while the poor live on their dry crops of pulses and inferior millets. It is in the rice country that garden cultivation is typical ; the regur lands on account of their non-irrigated character and great fertility do not lend themselves to intensive cultivation as the red soil lands do. Here the problem is no longer as it was on the regur lands, that of more intensive cultivation. It is the contrary ; cultivation is already intensive, it must be made more extensive. Thus, with improvements in irrigation facilities, the slopes of the hills are being terraced and embanked for rice ; manuring is receiving more attention so that the poorer lands can be more highly cultivated to relieve the strain put on the fertile valley lands. It is the pressure on these fertile valley lands which has caused so much emigration from the region in later times to the plantations of Malay or Ceylon, the labour of which is mainly derived from the Tamil country of South India.

A further interesting comparison which may be drawn is that of the extent of commercial cropping in the two areas. It can be seen at a glance that the jowar zone is far more under commercial cropping than is the rice zone. This arises from several factors, physical, commercial, human and political.

The regur plains offer the requirements for the growth of cotton, wheat and linseed, far more so than do the rice regions. Practically throughout the regur zone soil and rainfall conditions permit of the growth of these crops, while it is only in very restricted areas of the rice zone that conditions are suitable.

Secondly, an essential requirement of commercial cropping for raw materials such as cotton, or food grains such as wheat, is large scale production. For this the vast regur plains offer exceptional advantages in their extent of suitable land, and though methods of production are not yet such as to promote as large an out-turn as that of which they are capable, yet they stand in great contrast to the red soil regions. Here cropping on a large scale is a physical impossibility, save in a few favoured regions like the wide fertile valley of the Wainganga. The best soils are restricted and scarce, and the very intensive cultivation required is not at all the type suited to growing commercial crops like wheat or cotton in large quantities for raw material. The only commercial crop is groundnut, which is typically one of intensive cultivation. Moreover, in this region population is very dense, as shown by the map (Fig. 28) and in view of this, and the restricted extent of good soils, it will be apparent that from the native point of view commercial cropping is neither fair nor attractive. The native's first aim in life is to feed his family and his cattle ; he cares little for the world market outside if he is left alone to live his life as his fathers did before him. If commercial cropping can be made

attractive enough for him to adopt it, then his food must be largely brought from outside. Such a state of affairs cannot be sound, that of the cultivator growing commercial crops for export, while his food is imported. It is the root of many evils in the commercial exploitation of tropical lands, and is a matter for grave consideration in discussing the possibilities of extension of commercial cropping in India, in view of its myriads of native cultivators. The influence of food cropping on commercial cropping even in the fertile regur lands is very marked. In the rich valleys of the Tapti, Purna and Wharda, commercial cropping as shown on the distribution maps (Figs. 17, 19, 23) is great, as also is jowar production. Yet jowar production here, in spite of more favourable soil and rainfall conditions, does not surpass, in parts is even not so extensive, as in the medium soils and less favourable rainfall tracts of the eastern Bombay Deccan. This arises from the fact that agriculture in this latter region is a very risky proceeding, and the cultivator prefers to grow a hardy food crop like jowar which will secure him against starvation, rather than a risky commercial crop, which, if damaged by the vagaries of nature, may not find a market, and is no use to feed him.

A final factor, which leads to the next section of this work, that of the human development of the region, is the character of the native population in the areas under discussion. The typical population over most of the regur areas is the Maratha, a virile and keen race as compared with the wholly Dravidian peoples of the rest of the peninsula. Moreover, it is the westerly part of the Deccan, and the fertile Berar and Nagpur plains, which have been constantly overrun through history, by the farthest waves of invasion from the northern plains, sweeping round the Vindhyan barrier in the west. The eastern and southern tracts have been largely free from such upheavals, and, as a result of their comparatively isolated existence, have literally stagnated, since contact with varying cultures is an essential of progress in its broadest sense. This is probably a factor in accounting for the more advanced commercial development of the western and northern regions. Further, must be taken into consideration the fact that the Bombay Presidency, the Berar and Nagpur plains, and the Madras Deccan, have been for some time under competent British rule, which has opened up roads and railways, and constructed irrigation works, and established order both in the interest of native agriculture and commercial cropping. It is a recognised fact that commercial cropping follows the roads and railways, where cheap transport for access to the world market makes them profitable.

The rice growing regions, on the other hand, comprise largely the native states of Mysore and Hyderabad. Mysore has rapidly attained to good communications, and commercial cropping is receiving scientific attention. But Hyderabad is only now beginning to improve her roads and railways and irrigation works. Her roads until very recently were in a shocking condition, and improvement is only now proceeding. The slowness at which the native administration proceeds as compared with the British is well illustrated by the case of Berar. This was formerly a part of Hyderabad, but was taken over by the British in the second half of the 19th century, in as undeveloped a condition as Hyderabad. Berar has now a very efficient system of communications, and is a big centre of commercial cropping, vitally affected by the world market. Hyderabad is only beginning to realise that there is a world market, and her commercial development is as yet in its infancy.

Facts such as these give ample reasons for the greater commercial cropping of the regur lands as compared with the red soil regions.

CHAPTER III.

STUDY OF RURAL ECONOMY OF THE DECCAN.

I.—AN OUTLINE OF AGRICULTURAL SETTLEMENT.

The Rural Economy of the region, though based primarily on production, cannot be understood in the present, without reference to the past.

The formative period in the life of the Deccan peoples is not to be found in their recent history. It has its origin in the dim past when man first entered the region, and the interrelation, essential for his existence between him and his environment commenced. It is to the fact that man has so little departed from his dependence on nature that Deccan life owes its extreme simplicity. It is essentially a land of peasant cultivators, grouped into a social and economic unit—the village. This has been its character throughout history.

The dominating factor in the early history of the Deccan was its isolation. On two sides it was cut off from the world outside by the ocean, in those days an almost impassable barrier. The few traders who came to the coasts did not penetrate sufficiently far inland to influence the plateau country. On the third it was separated from the rich plains of North India by the rugged, forested, mountain country of the Vindhyas, affording no easy avenues of movement save at their western end on the alluvial plains of Baroda and Gujarat. Through the western corridor swept the waves of migrations which had entered the fertile plains of North India through the passes of the north-west, and, on the plateau they spread out over the north-western Deccan, and along the Tapti valley to the plains of Berar and Western Nagpur. But they, being but the farthest ripples of invasions from the north-west, had lost their intensity as they reached the south and east of the Deccan, so that throughout the ages this region had a relatively undisturbed existence, and the life of its earliest settlers has crystalised, so that in a large measure it is still the life of their descendents to-day. These historico-geographical facts present rather an analogy to those of China where the rich northern plains have been constantly swept by hordes of ruthless invaders, while the southern more inaccessible regions have passed a relatively undisturbed existence. Like China too, Deccan isolation has been broken by the West, not via those old avenues of advance, but by that closed to the early invaders, the sea. From the coast settlements, the West has worked its way inland, till it has extended its sway over the whole plateau. This is so recent an occurrence, that its influence on the crystalised life of centuries has been only very slight as yet.

To its earliest settlers the Deccan was no garden. It was a rugged plateau land, of forest and jungle on the lower hill slopes and in the valleys, or scrub in the drier parts, in which the aborigines pursued a nomadic hunting life, and a little shifting cultivation in clearings in the forests. These primitive peoples were followed by the Dravidian tribes, who entered from the north. With the big influx of peoples into the region, and their increase within it, the hunter was restricted to a more limited area, and forced more and more to clear land for cultivation. At first shifting cultivation (as is still pursued by the more primitive tribes in the most inaccessible regions) was the rule, but several factors combined to make these Dravidian tribes adopt permanent agriculture.

The main one was the rapidly increasing population, which by continually restricting movement, forced man to a sedentary life. The conditions of life

determined the mode of settlement which later became the village. The difficult task of clearing the jungle for cultivation necessitated co-operation, and naturally those peoples most nearly related to each other, the members of one tribe or clan, combined to perform the work. This tendency may have operated among the aborigines as among the Dravidians, and the idea of the village may have started prior to the Dravidian settlement.

A second factor tending to concentration was water supply. Where water was available, there population concentrated, since water was scarce and difficult to obtain on the Deccan.

A final factor cementing this concentration, was the necessity of security from attack. A settlement was in danger on all sides from the incoming tribes, the aborigines, and the wild beasts of the jungle, and combination for mutual defence was essential. These factors are the *raisons d'etre* for the Indian village. The typical village form was that of a tribe or clan, within which each member possessed his own holding, and over which was a headman or patil, not the owner of the village, but merely its head for administrative purposes. This is the typical Dravidian village, and the present village of South India is the modified but direct descendent of it.

The next step is to trace what influence the successive Indo-Aryan, Mohammedan, Mogul, Maratha and, finally, English dominations have exerted on this village type.

There exist in India to-day two distinct forms of village, the "*ryotwari*" or "*severalty*" village, and the "*joint*" village.[1] The former is the typical Dravidian village, and is characteristic of practically the whole of the Deccan. The "*joint*" village is one in which the village land is no longer owned by separate cultivators, but owned in shares by a dominant class, and either cultivated by them, or rented out to other cultivators. This type is typical of North India, the Punjab, North West Provinces and Oudh. The holdings are thus shares of a unit estate, and not a group of separately owned lands. This fundamental difference is reflected in the present revenue administration. The ryot of the South Indian village pays his own assessment, through the headman, directly to the Government, while the joint village has all its land assessed as a unit, and this assessment is often raised to the detriment of individual rights.

This fundamental difference has arisen from events which occurred after the Dravidian settlement. The ryotwari village once extended throughout India, but, with the incoming of the Indo-Aryan peoples, a conquering class was super-imposed on the old village type, and in the course of time it became no longer a group of separate holdings, but a unit which the dominant class shared between them, the old owners becoming mainly cultivating tenants. The distribution of these village types fully bears this out, since the "*joint*" village is typical of the regions affected by the Aryan migrations, while in South India, where the Aryans did not penetrate, it is entirely absent.

Later invaders who reached the Deccan, altered the ryotwari village little. They were not great enough to affect the masses of the people, and merely collected revenue from the villages, being the ruling class. The Mogul rule throughout aimed at preserving the village type, so also did the Maratha. Traces of Maratha supremacy, however, may be found in the Bombay Deccan where something akin to the landlord village exists in one or two places. These are attributed to some Maratha military castes who once owned the land, but probably perished in the wars.

1 Baden-Powell. "The Origin and Growth of the Village Community in India."

Thus it is, that South India is the home of the typical ryotwari village " the natural and comparatively little changed result of an ancient settlement of the country, under tribes of which the village groups formed small sections, each under its leader. In course of time the tribal feeling died away—the several holdings became not only separately held, but without any connecting link of tribal organisation." Such was the position when the British became the rulers of India, and, like the Moguls and Marathas before them they made no attempt to alter the village form. Their administrative dealings with the village lay in the collection of the revenue, since, although the ryot is in practice the owner of the land, the state has from ancient times in India theoretically owned the land, and has claimed a fixed portion of its produce. This portion received a definite assessment in the reign of Akbar[1] when the land was valued on its soil type and its productivity. The payment was one-third of the produce of the land, at first paid in kind, but afterwards changed to a cash payment. This greatly affected the village, in that the money payment was assessed for the village as a unit and not on the separate holdings. During the decadence of the Mogul Empire this system might have meant the rise of a zamindar class on the Deccan as it did in Bengal, were it not that the Marathas were keen financiers and did not allow the revenue farmers to get out of hand and become landlords. The British, when they took over the government reverted to the method of collecting the revenue from each separate holding through the headman. This necessitated a basis for assessment. Many systems were attempted, but the present form is that "the land revenue is a tax which has some of the characteristics of rent, and varies from field to field according to the fertility of the soil and other natural advantages."[2] The tenure is one of full ownership of a " hereditary and transferable property " ; the ryot may cultivate the land himself or sub-let it to others. He is guaranteed under the Bombay Government that his land shall not have an increase of assessment for any improvements which he shall effect. His assessment is such that he will be well able to pay, and is liable to revision every 30 years. Apart from the " inam " lands, which are special lands owned by such bodies as the village temple, or a particular village officer, and which are immune from revenue tax, most of the Deccan land is held on the tenure above described and known as "ryotwari." An exception is found, however,in parts of the Central Provinces,notably the eastern parts, and in the native states; also in isolated districts throughout the plateau, where the system is similar to that in Bengal. The villages are owned by a land-owning class the " zamindars." These, under the Mogul Empire were the government revenue collectors, who, at its decadence gained control over large areas. Under the famous Bengal Settlement of Lord Cornwallis[3] these revenue officials were made landlords of large areas over which they were to act as the Government revenue collectors. The system is much condemned, in that the masses are often miserably oppressed by the zamindars. But whether of the ryotwari or zamindari type, the Deccan village differs not at all in its life, which is based not on methods of land holding, but on its agricultural production.

II.—PRINCIPLES UNDERLYING THE ECONOMY OF A DECCAN VILLAGE.

The study of the rural economy of the Deccan is necessarily the study of the rural economy of its villages ; this economy depends primarily on the production of the village, but many other factors enter into consideration in any study of Rural economy, factors of communications, markets, industries

1 1556-1607.
2 Keatinge. " Rural Economy in the Bombay Deccan," 1912.
3 1793.

and labour supply. These factors are not uniform throughout the region, and since any study of them is closely bound up with a study of the influence of the West on the village, it has been thought best to briefly describe the typical economy of a Deccan village prior to the introduction of roads, railways, commercial cropping and industries, and to discuss the rural economy of the different production regions in view of all the factors physical, social and economic combined.

Prior to the introduction of roads and railways the Deccan village was an entirely closed economic and social association. Each village had its dwellings and its well or tank for water, beyond this were its cultivated fields, and beyond this again its waste, either wood or grassland, for collecting fuel and grazing cattle. Most of the members of the community owned their own plot of land and on it grew their own food, and as far as possible, the material from which to weave their cloth, or provide such household necessities as oil. The labour for cultivation was supplied by the members of the family, and the periods when agriculture was at a standstill were employed in weaving, metal work, wood or leather work, and all the other cottage handicrafts for which India was so famous. The village servants, the blacksmith, the carpenter, the goldsmith and the potter worked for the village, and were supported by it, receiving payment at harvest time. Also important in the village was the savkar or moneylender, who lent money either for agricultural or social purposes. The community had little outside association,save for the occasional visits of the grain or cloth merchant, who carried the surplus of one village to supply the deficiency of another, or for occasional journeys to the large centres to sell the products of their craftmanship. These journeys being undertaken by pack bullock over rough and dangerous tracks, were not frequent.

The life of the villager was dependent on the rains. During the wet season he grew his main crop of rice and millet, perhaps also he grew a crop in the rabi season if he possessed irrigation facilities or " rabi " land. During the hot season he normally took his holiday, since agriculture was suspended ; it was the time of the social festivities in which all the villagers joined.

In this secluded atmosphere the ryot lived and died, unconscious for the most part of the world outside ; he was bound by family and caste rules to follow the occupation of his forefathers, and was neither desirous nor able to break away from this age-long system of life. The picture is not an unpleasant one, but it has its dark side. The village, cut off from outside intercourse was entirely dependent on its own production for its existence. Should the rain, upon which its crops depended fail, then starvation and death were the result, and it was not an infrequent occurrence on the Deccan. Even when the rains were sufficient life for the majority was still hard. Scanty rains, and moderate or poorly productive soil, often yielded barely enough for the ryot to live on and feed his cattle. Dwellings were poor and insanitary, water often stood in the tanks and wells for long periods and was used indiscriminately for other purposes than drinking ; as a result disease was rife, and medical aid not forthcoming. The following description of life in an Indian village by an Indian[1] shows this dark aspect of its life : " The ill-clad villagers, men, women and children, thin and weakly, and made old beyond their years by a life of underfeeding and overwork, have been astir before daybreak, and have partaken of a scanty meal consisting of some kind or other of cold porridge of course without sugar or milk. With bare and hardened feet they reach their fields and immediately begin to furrow the soil with their lean cattle of a poor and hybrid breed, usually sterile and milkless. A short rest at midday, and a

1 The Aga Khan. " India in Transition."

handful of dried corn or beans for food, is followed by a continuance till dusk of the laborious scratching of the soil. Then the weary way homewards in the chilly evening, every member of the family shaking with malaria and fatigue. A drink of water, probably contaminated, the munching of a piece of hard black or green champatire, a little gossip round the peepul tree, then the day ends with heavy unrefreshing sleep, in dwellings so insanitary that no decent European farmer would house his cattle in them."

Into this land of villages came the West, with its roads and railways, its irrigation works, and its commercial and scientific farming, perhaps to darken the bright side of the picture, but certainly to brighten the dark side, and it is to be hoped that the latter more than compensates for the former.

Its first proceeding was to open up the country with roads and railways, bringing the villages not only into contact with one another, but with the world outside. This latter fact has been the greatest in altering the rural economy of the regions which were affected by it, for the villages of these parts lost what had been their definite characteristic—" isolation." They were drawn into the great world system, and the result on agriculture was shown in the development of commercial cropping, chiefly of cotton and oilseeds. The cultivator near the railway found that if he could produce cotton or oilseeds on his land, transport was available for him to send them to the big centres where they were in demand for export, and where they would yield him a higher return than his food crops. These latter he could grow on part of his land and buy what he lacked from the profit on his commercial crop. He became definitely influenced by the world market ; when prices were high he extended the area of his commercial crop, and reduced the food area ; when prices were low in the world market he extended his food area and reduced his commercial crop. Thus regions before devoted to all round production to satisfy native wants, became specialised growers of one or two products. Commercial cropping was further encouraged by the railways, in that the ryot, knowing that food could be brought into his area by rail if there was a shortage, was more willing to risk growing a commercial crop, where before he was either forced to grow a food crop or starve. Thus in suitable areas for commercial cropping, the production of the village became altered to suit the requirements not of the village but of the world market. This fundamental change in production changed also the Rural Economy of the village, since that was based on production, with the result that the essential differences in the rural economy of the villages are intimately related to the extent to which they are commercially cropped. Here a broad distinction can be drawn between the zone of jowar and its associated products, and the rice zone and its associated products ; the former is typically the region of the Deccan which shows commercial cropping and all its attendant influences at its best, while the latter shows commercial influences as yet only slight, but nevertheless becoming effective. Since the effects of the change necessarily assume different aspects in relation to different types of production they may be studied in relation to the different production regions.

III.—RURAL ECONOMY IN PRODUCTION REGIONS.

A.—RURAL ECONOMY IN THE JOWAR ZONE.

Two main production divisions have been discussed—the cotton-jowar-wheat-linseed-pulse association of the richer soils and more certain rainfall tracts, and the cotton-jowar-bajri-pulse zone of the medium soils and more precarious rainfall regions. Any differentiation of rural economy in the two regions is only of degree of the same type ; both have the same food and fodder

crops as their basis, and both have cotton as their dominating commercial crop. The former region, however, being the more favoured by nature, has a greater extension of commercial cropping, more developed communications and industry, and a denser population.

The outstanding feature of cultivation in the region is that it is " dry " ; irrigation is negligible both on account of the high cost and risk of boring wells in the region, and the natural retentiveness of the soil. The wells are confined to the village site where they are required for drinking, cooking and washing purposes, and sometimes used to irrigate small crops of vegetables.

The food basis throughout the region is jowar and bajri millet, and various pulses. The significance of the millet pulse association is great. Millet is a highly starchy food, jowar having 72·3 per cent. of starch while bajri has 71·5 per cent.,[1] and, for a healthy diet, such foods must be supplemented by protein, in most parts of the world taken in the form of meat. India, however, is a non meat-eating country, and her protein supplement is supplied by the pulses, gram as typical containing 22.2 per cent. of protein. Pulses are grown throughout the plateau on rich and poor soils alike, and are just as important in the rice regions as in the millet regions.

The significance of the millets in village economy is two-fold, in that they not only feed the villagers, but support also the village's most precious possession, its cattle. The cattle of the village are kept neither for food nor for milk production, but as field workers and beasts of burden. On the cattle the cultivator depends for the ploughing of his field, the raising of his water from the village well, and the carriage of his produce to market.[2] So intimately are the cattle a part of the village economy, that the prosperity of the village is generally reflected in the number, size and strength of its cattle. The great difficulty of cattle keeping on the regur plains, which are the jowar regions, is fodder. The best grazing grounds of India are her forests and these are entirely absent from the regur lands ; nor is this lack supplied by grass land—every available bit of good soil is used for cultivation, and the poor stony uplands will not grow grass. The cattle thus are dependent on the fodder crops grown, which are jowar and bajri stalk, and pulse husks. The jowar stalk is much superior to bajri stalk, and the fact is reflected in that the cattle of the jowar zone are much superior to those of the bajri areas. The problem of the region however lies not in the type of fodder but in the amount ; particularly is the problem serious in the dry tracts of the East Bombay Deccan. Here the kharif fodder crop generally suffices to carry the animals through till the beginning of the hot season. From then, they are practically scavengers over the hard, barren fields, and by the end of the hot season are lean, weak and often diseased. In this state they are expected to plough the lands after the first fall of rain, with the inevitable result that the land is badly tilled and the crop suffers. This evil is further enhanced, in that many of the cultivators cannot, on account of expense, afford to buy and keep bullocks. A good pair of working bullocks costs Rs. 120 to Rs. 800[3] or more, but it is not only this that debars the poor cultivator from possessing his own bullocks but the fact that they consume about one-third of the produce of the small holding. He therefore hires them, and the land is ploughed the minimum

1 See Table showing constituents of Indian Food Grains, p. 82.
2 Keatinge calculates that on the Bombay Deccan there are 137,100 cattle engaged in cultivation. (" Rural Economy in the Bombay Deccan.") This would give about one pair of plough cattle for twenty acres of land, but from this number must be deducted the number of cattle engaged in raising water and carting on the roads. Of the number given, 20 per cent. are practically useless, and 10 per cent. ineffective.
3 Keatinge. " Rural Economy in Bombay Deccan."
4 Report on improvement of Indian Agriculture. 1893. Voelcker.

number of times, which is further to its detriment. Moreover, it does not get the manuring that is required. The region being forestless cannot obtain wood for fuel, and so it burns its cattle dung, the most valuable of all manures. Voelcker[1] deplores this as one of the greatest evils of this region ; the soil is continually being robbed of constituents which are never returned to it, and this in time is bound to have a detrimental effect on production. The providing of fuel and fodder supplies in these regions of the Deccan is one of the biggest problems which agricultural improvement has to face, since, indirectly, it is the root of much of the bad cultivation of the region.

Jowar, bajri and pulses, and cotton for home use, were the staple crops of the region, until it became opened up by the railways under the British Government. It had always been the most progressive part of the Deccan on account of its position, but, the essential factor in its rapid development now became its naturally good basis for the production of commercial crops. These first became important in the richer and more certain rainfall tracts and along the railways throughout the region. The ryot found that he could now grow a crop which yielded him a much greater profit than his food crop, and which he could now market easily ; hence came the rapid development of the crops of cotton and oilseeds for export, which wrought such enormous changes in the life of the village.

The main commercial crop is cotton, and its importance lies not so much in the fact that it yields a much greater profit than jowar or bajri, but because it is a very hardy crop and can be grown successfully throughout the region. The profit obtained from cotton in relation to jowar and wheat, can be gathered from the figures for a farm in the black soil country of Dharwar.

Crop.	*Extent.*	*Receipts.*	
Jowar and pulses	20 acres	Rs. 570	
Cotton and subordinate crops	20 acres	Rs. 698	this estimate is low even when price of cotton is moderate.
Wheat and Safflower	8 acres	Rs. 168	

In view of the increasing manufacture of cotton in India, and the exports to Japan and the continent, the acreage under the crop is continually increasing. This however, is not at the expense of the food growing regions, which are even now not producing sufficient to support their population (as proved by the large imports of food annually into the Bombay Presidency)[2] but at the expense of the wheat and oilseed lands, particularly of the former, whose growth now is being restricted to the very deepest richest soils where it is sure to yield a good crop. On the medium soils it is replaced by the hardier cotton crop, as it is not as profitable a crop to grow, either for food or export, as cotton. As the former it is not so much liked as jowar, nor does it yield as good a fodder, and it is neither so hardy nor so profitable as cotton. Moreover, the price of the seed is generally very high, and the ryot can not always afford to buy it. It is mainly grown where the land produces two crops a year, a kharif and a rabi, of which wheat is the latter. Where only one can be grown per year it is primarily jowar or cotton. Linseed holds the same position as wheat, in that it is restricted as a rabi crop to the richer and deeper soils. Safflower, castor, and niger oilseeds are rarely grown alone, they are generally mixed crops with millets or wheat.

1 Quoted by Keatinge—" Rural Economy in the Bombay Deccan."
2 109,283 tons of grain pulse and flour were imported into Bombay in 1921-22. (See " Sea Borne Trade of British India, 1921-22).

That the region possesses a good physical basis for commercial cropping is undoubted, but turning to the actual system of cultivation in the village we find it is entirely unsuited to commercial cropping, from the fact that the holdings are extremely small, and are becoming smaller. This is partly due to the Hindu law of inheritance which requires that when a man dies his property shall be divided equally among his sons, and partly from the increasing pressure of population on the land in view of the " Pax Britannica." The evil is present throughout the Deccan, but is very noticeable in the jowar zone which has been so much developed, and has experienced a big increase in population as a result. The evil is particularly bad for commercial cropping. The normal holdings are from 5 to 10 acres and for the village of Jategaan Budruk Dr. Mann gives the following details as to the size of the village holdings[1] :—

No. of holders with			more than 150 acres		....	1
,,	,,	,,	100-150	,,	....	1
,,	,,	,,	50-100	,,	.. .	5
,,	,,	,,	40-50	,,	....	4
,,	,,	,,	30-40	,,	....	6
,,	,,	,,	20-30	,,	....	16
,,	,,	,,	10-20	,,	....	43
,,	,,	,,	5-10	,,	....	34
,,	,,	,,	1-5	,,	....	25
,,	,,	,,	less than 1 acre	....	....	11

Thus 77 per cent. of the holdings are less than 20 acres and 48 per cent. less than 10 acres. In another village studied, Pimpla Soudagar, 81 per cent. of the holdings were below 10 acres.[2]

The evil is intensified by a system which existed in England prior to the Enclosure Movement—that of fragmentation of holdings. The ryot does not have his holding all in one piece, but scattered about the village in plots. The practice was originally intended to promote fair division of the land so that one should not get all the good land and another all the bad, but from the production point of view it is an unmitigated evil. The ryot cannot grow a successful crop if he has to wander from one end of the village to the other to cultivate different strips ; nor is the system conducive to good irrigation ; it does not pay him to bore a well if it will only be utilised on one little strip, and he must always consult his neighbours over any schemes of improvement. The following details again for the village of Jategaon Budruk, show the extent to which fragmentation has proceeded here. There are 561 plots in the village and 146 holders which means nearly 4 plots per holder. The size of the plots is as follows :—

Size of plots.	*No. of plots of each size.*
Over 30 acres	3
20-30 acres	8
10-20 ,,	51
5-10 ,,	95
3-5 ,,	69
2-3 ,,	58
1-2 ,,	98
Below 1 acre	178

1 Land and Labour in a Deccan Village. Study No. 2. 1921.
2 Land and Labour in a Deccan Village. Study No. 1. 1917.

Not only is this type of holding radically unfit for any large scale commercial production, but the smallness of the holding, and the excessive fragmentation is unfit as a basis for any cultivation ; it is not an economic holding. Keatinge defines an economic holding as one which will suffice to provide the cultivator and his family and cattle with sufficient for their necessities and a small surplus for pleasure. This most of the holdings do not do, and we thus have the second great evil of the village—indebtedness. The ryot is constantly in need of money to buy his seed or to pay for his social activities, and this he borrows from the savkar or moneylender, either on a crop or land security. So consistently does he borrow, and so little can he pay back, that he is constantly burdened with debt. This is not only morally bad, but the ryot is not able to make any improvements on his land, and, if he knows that all his crop is going to the savkar, he does not put so much energy into its cultivation as he might do. It makes little difference to him whether his crop is good or bad, as the savkar rarely gives him the true value of it. The greatest evil, however, lies in the fact that when his land is given as a security, under the terms of his tenure[1] it can be confiscated by the savkar, and he becomes a landless labourer. For years past the census returns show an increasing number of this landless class, and the fact that in 1875 so much of the land had gone into the hands of the savkars, led to riots. The only remedy was to curtail the transferability of property, and some attempt was made to stop the practice by the Deccan Agriculturists Relief Act in 1879, and the amendment of the Land Revenue Code in 1901, but it has not been effectively stopped. It is questionable whether the passing of the land into the hands of a moneyed class is not better for the production of a region, than when it is in the hands of paupers, who can afford no outlay whatsoever on it.

Yet, in spite of the unsatisfactory land basis commercial cropping still extended. With the continued pressure of population on the land, land values rose, and, since more and more land became taken for commercial cropping, food prices also rose. Further than this, the extension of the roads, railways, irrigation works and industries, called for increasing supplies of labour which decreased the availability of labour for agriculture, with the result that wages rose. A rise in wages necessarily meant a rise in prices which affected the whole of village society, not, however, uniformly throughout all classes. Keatinge distinguishes four classes of cultivators and shows the effect of the use of prices on each. Firstly there are the land owners who either cultivate the land themselves with hired labour, or lease it out to tenants. These, when it has not paid them to cultivate with hired labour, have benefited from the high rents obtained from their tenants, owing to the increase in land values. The second class is the cultivator who owns an economic holding. His land value has increased, and since his holding is capable of producing a good crop, he too has benefitted. The third is the cultivator with a uneconomic holding, who is most typical of the Deccan. His is the worst case of all. His land is not sufficient to produce a good crop, and with the rise in prices he is hopelessly in debt to the savkar. The result in many cases is that he has lost his land, and become a landless labourer. This labouring class has distinctly benefitted from the rise in wages, though in view of the rise in prices this may not seem much of an advantage. The greatest benefit derived by the labourer from the introduction of the roads and railways and industry of the West is ' Mobility.' No longer is he tied to the village as a servant. He may work on the land during the agricultural season, and, instead of wasting the rest of his year, he may find employment in the towns and on the railways. Dr. Mann, for the village of Jategaon Budruk, shows that there is not only an

1 See page 71.

emigration of labourers from the village to the town, but also of the poor cultivators whose land will only produce one crop a year. This latter fact is the basis of one of the grave charges brought against the introduction of industry to the region, which in the cotton growing districts is developing rapidly, particularly at the big centres of Bombay and Nagpur.

Prior to the introduction of industrial establishments into the country the cultivator was generally working on his land 6-8 months of the year. After that he could do little, since the land was incapable of cultivation in the hot season unless he had perennial irrigation. This period he either spent in holiday, or in "cottage industry," typical of which in these regions was hand weaving, and oil pressing. The introduction of cheap western machine-made cloths, cheap oil, and cheap metal and wood goods, have stifled these cottage industries, and the craftsmen, instead of pursuing their craft at home have left the village and gone to work in the big factories. This system means thus the death of village craft, some of which was the most beautiful of its kind. "India is in the throes of an industrial revolution—the village, a self sufficing economic unit is attacked by the sudden introduction of competition from the world market—local industries are suffering, many things are tending to shake the old immobility of labour."[1] For the landless labourer the system is not detrimental, but for the poor cultivator the effect on agriculture is bad. He is away from his land for part of the year, and it does not, therefore, receive proper attention. He comes home at the beginning of the rains, sows his crop, harvests it at the end of the rains, then returns to the town after doing the minimum amount of labour possible for his crop.[2] Such a system is radically bad for agriculture in any region. The danger of the situation is that the village might become the handmaid of the city, and this in a land of agriculture is fatal. It is held that the best of the agricultural population and rural artisans have withdrawn from the villages to supply the labour demand of the towns, which offer higher wages, so that agriculture, upon which India bases her life is suffering. "The movement of the population from the village to the city is in fact, not only working a complete revolution in the habits and ideals of our people, but its economic consequences are far more serious than are ordinarily supposed. It has made our middle class helplessly subservient to employment and service, and has also killed the independence of our peasant population. It has jeopardised our food supply, and is fraught with the gravest peril not only to our handicrafts, but also to our national industry, agriculture; the Indian factory hand is primarily an agriculturist—his real home is his native village and not the city where he works."[3]

This discussion on the influence of industrialism may seem a digression, but since it is operating in the jowar-cotton zone more forcibly than anywhere on the Deccan, it enters very seriously into the study of the rural economy of the region. Even if the old village community spirit cannot be revived, the ideal which underlay it is being revived in the rising spirit of co-operation, now apparent in the most progressive regions of the Deccan, of which the jowar-cotton zone is typical. Co-operation is an attempt to supply the various facilities for agriculture which the ryot cannot supply on his own. It finds expression in the Co-operative Credit Societies which supply the capital necessary for agriculture to the ryot as loans, without his having to resort to the savkar, or in co-operative sale societies, which attempt to sell his produce

1 Mukerjee—"The Foundation of Indian Economics."
2 For the village of Jategaon Budruk, Dr. Mann shows that of a population of 736, over 200 went annually to Bombay to the cotton factories, and a large proportion had been going for 20-25 years, either for 4 or 8 months each year.
3 Mukerjee—"Foundation of Indian Economics."

for him without dealing with the middleman who is one of the greatest evils of trade in India. The farmer, when the middleman has deducted his profits, rarely gets a good price for his crop.

A co-operative credit society is formed by a body of cultivators, and the capital of the society is made up of members' subscriptions, of Government or private loans, or of loans from Central Agricultural banks, which raise money by private loans and by Government grants. The movement was introduced only in 1904, but the figures for 1923 show that it is very flourishing.

The ryot once he has grown his crop, does not have to turn it over to the savkar, but must sell it to the merchant. The process is a difficult one, since the merchant has to receive the produce of numerous small holdings marketed generally in a very bad condition, and this is very unsatisfactory in view of the different grades of every crop. The co-operative marketing societies are an attempt to collect the produce, grade it, and see that it is marketed in a proper condition. The system is more satisfactory both for the cultivator, who gets a better price for his goods when he has not the middleman's profit deducted from it, and for the merchant who receives his goods in a proper condition. The system has a particular significance in the marketing of cotton, in that it is no use for a cultivator to grow a pure strain crop of cotton if it is to be mixed up with an inferior quality from another small holding. Excessive adulteration is applied to the cotton by the middlemen, and it is the cultivator who suffers in the long run. The work that lies before the co-operative cotton marketing societies is, to quote Keatinge[1] " of great magnitude and difficulty. Their operations are bound to raise the enmity of interested dealers ; but if they can undertake careful grading and establish a reputation for honest dealing they will accomplish a great work, not only for the cotton cultivators, but also for the cotton trade in India."

The same principles may be applied to the wheat trade ; wheat is notoriously adulterated in India and therefore receives a lower price than it might do in the world market. Also, co-operation in the oil seed trade might make possible the establishment of central oil pressing mills, which would allow of the seed being crushed in India, and the oil cake, a valuable cattle food and manure, being retained in the country. Co-operation in the eyes of many is the lodestar of Indian agriculture, and in it lies her hope for the future, since agriculture will always be her main occupation, both to feed her own population or to supply raw materials for her own country or for export.[2] It assumes a big significance in the jowar-cotton-wheat-linseed-pulse zone, in that this is the region of the Deccan with the greatest future for commercial cropping, and the success of the latter is bound up with co-operation.

THE BAJRI-GROUNDNUT-PULSE-GARDEN CULTIVATION ZONE.

Two distinct types of rural economy exist side by side in this region, that of the poor soil village of the east-west spurs of the Ghats or the hilly parts of the Western Ghat slopes, and that of the rich valley village of the Western Ghat slopes.

1 " Agricultural progress in Western India."

2 It is thought by Mukerjee that co-operation may be the saving grace of the cottage industries, since they might be capable of supplying requirements which are too small to tempt the power mills—particularly the hand weaving industry ; he thinks that " the cottage industries are still living forms of our economic organisation, which, if certain improvements both in the mechanical processes as well as in the general character of the business management are adopted have a great future before them—only by a system of co-operation the small industry can secure the economies of production without which it cannot survive the stress of the economic struggle."

The cultivation in these valleys is typically intensive as compared with the extensive cultivation of the regions to the east, its crops being sugar cane, groundnut and vegetables. To it the West has brought benefits in the form of irrigation works, railways and markets, and the ryot with the advantage of these facilities has prospered far in advance of his brother to the east.

What is the result of this type of cultivation on the cultivator ? The fact that he possesses irrigated land is important in that he need not leave his holding for long, if ever ; moreover, he knows that what crop he sows he will reap, in contra-distinction to the East Deccan cultivator, and this fact is stressed by Keatinge as one of the prime causes in the very careful cultivation of the West Deccan farmer as compared with that of the East Deccan farmer. Moreover, being in a more prosperous condition than the East Deccan farmer he can generally afford his own well and can then live on his holding. The fact that the East Deccan farmer is away from his holding, since he has to live in the village where there is a well, is one of the gravest faults in the region, and is a big factor in accounting for the poor standard of cultivation in the East Deccan. This careful cultivation and good water supply of the West has resulted in a body of very prosperous cultivators, who grow sugar cane, groundnut, and vegetable crops which require a large outlay but give a good return. Sugar cane cultivation is chiefly centred round the big irrigation canals which give a perennial supply of water. The cost of cultivation of the crop is high being Rs.500 to 700 per acre,but the yield is as high as 7,000 to 11,000 lbs. of gul per acre,[1] and the average net profit about Rs. 150 per acre. The return it gives thus more than compensates for the outlay, and it is said that the sugar cane pays most of the revenue of the irrigation canals. Much loss is experienced in the manufacture of the cane into sugar by the old native methods, and, in view of the large home demand, an improved Western method would be very beneficial. It is held, however, that modern sugar crushing plant to replace the old bullock driven machinery would require a large and assured supply of high-class cane to make it pay, and this cannot be obtained from the small holdings of unskilled cultivators. What each mill would require is a sugar cane estate of its own. Throughout India the problem is the same, that of the impossibility of creating a profitable sugar industry on western lines and so reducing the enormous imports, because of the minute holdings and unskilled production. In the Bombay Deccan the prosperity of the canal areas, which are enormously costly, is bound up with the extension and profitability of the sugar cane industry.

Groundnut is again a crop of intensive cultivation in the region, and requires for a good return a big outlay, particularly on labour, but the return compensates. Its cultivation is not entirely confined to these garden lands, but on the poorer soils, the groundnut farmer is always the richest among the cultivators. Groundnuts are primarily grown for export, but, though some are crushed locally the greater part are exported as nuts. This latter fact is deplored by Voelcker[2] in that the oil cake, which is both a valuable manure and cattle food, is not retained in India. The fact assumes a great significance in the sugar cane regions, in that sugar cane requires very intensive manuring, for which groundnut is very good as it contains 7.8 per cent. of nitrogen. Moreover, in this region where little millet is grown save bajri, and where cattle are required to perform the arduous tasks of crushing the cane and carting produce as well as cultivating, an additional good fodder is very requisite, and could be well supplied by groundnut cake.

1 " The Crops of the Bombay Presidency." P. C. Patil. Bull. No. 109, Bombay Dept. Agriculture. 1921.
2 Voelcker, " Report on Improvement of Indian Agriculture. 1893."

Vegetables and fruits typical of market gardening are less extensive, but still more intensive forms of cultivation. The crops are irrigated from wells, and though only small, are very profitable. Their extent is greatest round the big towns which they supply with fruit and vegetables and from which they derive great profit from having a sure market. The importance of the towns is reflected in the fact that 72 per cent. of the area under potatoes in Bombay is in Poona, the chief centre of the Deccan. The different tracts specialise in different crops; thus potatoes are grown in Poona, onions in Niphad (Nasik), figs and oranges in Purandhar (Poona) and tumeric in Satara. The profits on these are high but necessarily vary with the skill of the cultivator, and also with his distance from a market. If he is not near a market, then his time is better spent growing crops of grain or fodder which he might use in rearing cattle. Keatinge suggests that the time and care required in the breeding of stock would take up much of the cultivator's spare time and use it profitably. A distinction may be drawn between the east and west Deccan in this respect. In the east where water is scarce, it pays the cultivator to confine himself mainly to his few staple crops, and not to concentrate on small sources of profit like fruit or fodder or fuel growing. In the west, the small holder usually pays his way from such sources, and though the holdings are generally smaller than to the east, yet the standard of cultivation is higher. Every farmer of the region is not however, in this happy state, and the standard of cultivation and of comfort in the village of the poor rugged country growing mainly pulses and millets, is very low. These soils being kharif lands can produce only one crop a year, unless there is small irrigation from the well; this is employed in growing vegetables. The importance of subsidiary occupation in a " dry " village such as that of Pimpla Soudagar, [1] particularly in the spring, is shown by the following table :—

Numbers and occupations of those working away from the village in Spring, 1916.

Working in ammunition factory—Kirkee (5 miles away)	89	Total male pop. of village 283 —31.4 per cent have left.
Employed carrying milk to Poona and selling it there	10	
Carting on the roads, chiefly with their own carts	4	
Artisans	4	
Labourers	14	
	120	

Note.—The total population is 556.

In this village it has been calculated that of the 103 families in the village 8 are in a sound economic position, 28 are just on the margin of an economic position, while 67 are economically unsound, and living below the standard; 14 of these latter have no land, and the others are poor cultivators. The indebtedness of this class is higher than any of the others, but so poor is cultivation, that if all indebtedness were removed 50 per cent. of the families would still be economically unsound. The land must be made to yield more than at present. This is the state of a typical " dry " village, and it is noteworthy that the proximity of two large towns; Kirkee 5 miles distant, and Poona 8 miles, has permitted of the labouring population remaining in the villages. Where the villages are far from the big towns some of the villagers are absent for a large part of the year, and some families sever their

2 " Land and Labour in a Deccan Village." Dr. H. Mann. 1917.

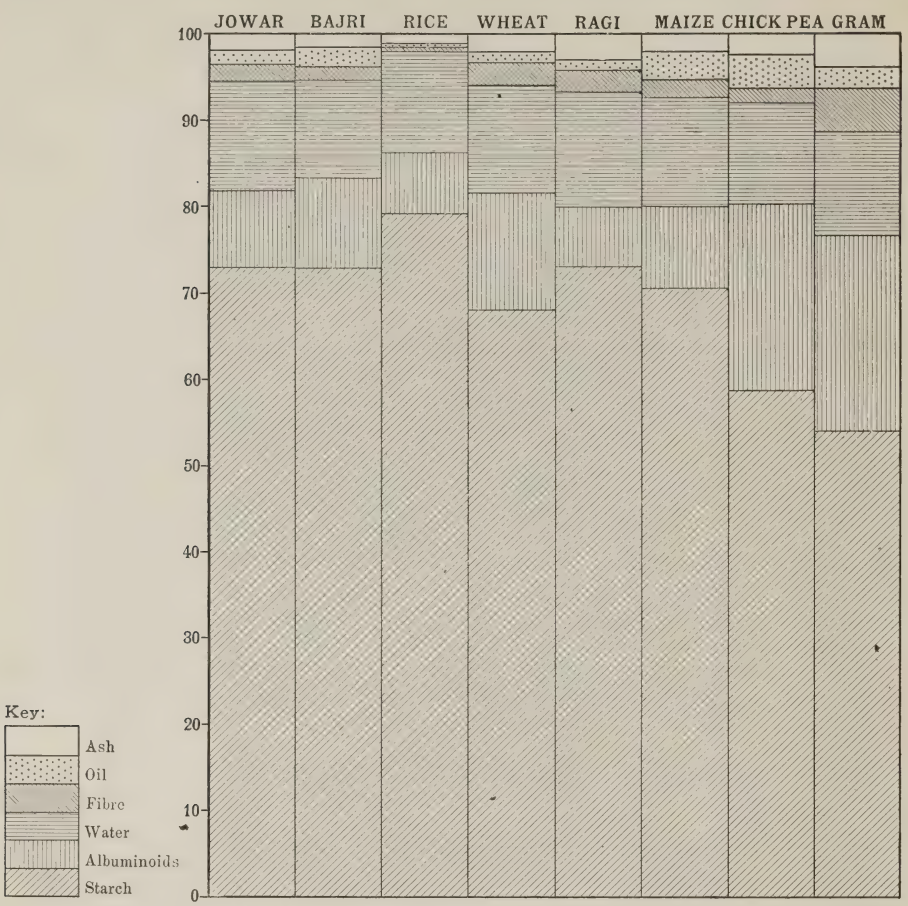


FIG. 27.

Table showing constituents of some Indian food grains
(Based on analyses by Church).

connection with the land altogether. The position is very similar to the poor village of the East Deccan. The complementary nature of the East and West Bombay Deccan in view of the different production bases is significant, in that the West supplies the cotton-grain country with sugar, while the East supplies the West with large quantities of grain.

B.—RURAL ECONOMY OF THE RICE ZONE.

The rural economy of the region differs from that of the jowar zone for two main reasons, firstly, it is primarily a region of " wet " and not " dry " cultivation, and secondly, as it is mainly a region of food and not commercial cropping, it is as yet not nearly so much in touch with the world market as the jowar zone. Hence we find in these regions, the rural economy of the village far nearer to the simple state. Economy throughout the different production associations of the rice zone is very similar and may be discussed as a unit, but with reference to the modifications arising where commercial cropping is practised. The typical village of the rice zone consists of the village houses,

tanks and wells, around which are the irrigated fields, beyond these the unirrigated fields, and beyond these again the waste.

The Telingana of Hyderabad, which was the core of the rice-pulse-millet-sesamum region, shows this typical village. The region has neither extensive communications, nor commercial cropping nor industry, and the village lives mainly on the crops it produces, rice and sugar cane on the irrigated lands, and millets and pulses on the " dry " fields. The association of rice and pulses has the same significance as did that of the millets and pulses in the regur zone. Rice contains even more starch than do the millets, 78·3 per cent., and the health of the rice eating peoples is dependent on a supplementary diet of protein, which is supplied by the pulses. Yet a distinction arises between the food basis of the rice country of the Deccan and that of the jowar lands. Rice, being an irrigated crop, is necessarily more expensive to grow than a dry crop like jowar ; it is an intensive as contrasted with an extensive crop. Thus, instead of having, as in the jowar zone, one staple food crop for rich and poor alike, we find in the rice zone that rice is the staple food of the richer cultivator, while millets and pulse are the food of the poor cultivator who owns dry lands only. The paddy cultivator normally grows his rice crop during the kharif season, and grows his pulse or oilseed crop after the rice is harvested. The crop requires much care in cultivation and heavy labour at sowing, harvesting and threshing time, but is a very profitable crop to grow, the yield being about 1,000 lbs. per acre. The pulse crop is a cold season crop, but as it does not require much care, the cultivator often hires out his cart and bullocks during this period, and adds to his income. He rarely suffers as the cultivator further west, from failure of the rains. The intensive nature of the rice crop requires more care in cultivation that does the jowar crop, but the rice cultivator like the East Bombay Deccan cultivator suffers from the fact that his living house is not near his fields ; such a thing is inevitable in rice country. The enormous importance of rice is reflected in the density of population in the rice growing tracts. The more intensively grown is rice, the denser the population. The Telingana, unlike the Marathwara, does not call for labour in factories; there are none. During the hot season the villager either takes his holiday, or practises some subsidiary industry ; if the labourer does leave the village he has a great way to go to a factory town, and generally stays away from the village altogether. Throughout the region the standard of comfort is low, because of the smallness of the holdings, the great extent of poor land, and the dense population.

In the rice-wheat-linseed tract to the north in the Wainganga valley, life is not very much different. Neither wheat nor linseed approach in importance to paddy, but in view of the fertility of the land and its occurrence in British territory, the region has been far more opened up than the Telingana of Hyderabad, and now has good communications to the north, west and east by road and rail. The opening up of the country has shaken the stagnation of this rice country. Free from the overturnings which through history have beset the regur plains of the west, its cultivation remained in a very primitive state. The opening up of the country meant an increase in population, and the extension of irrigation meant an increased food supply. Then the region found that it could produce crops suitable for export, wheat and linseed. Wheat is grown only on the heavy soils which are the most fertile, and it is not the crop of the poor cultivator, who depends mainly on his paddy crop and its after-crop of linseed or pulse. During the hot season agriculture is at a standstill, but it is here that the influence of the neighbouring cotton country is felt. Large numbers of the population overflow into the cotton factories of Nagpur, while many also emigrate during the season of cotton picking which requires an enormous amount of labour, so much that the de-

mand exceeds the supply. The influence of commercial cropping in the western districts is reflected in the percentage of field labourers to total cultivators. In the cotton country it is as high as 59 per cent. in Wharda, 58 per cent. in Amraoti, and 48 per cent. in Nagpur, while in Bhandara and Balaghat rice country, it is only 35 per cent. and 31 per cent. respectively. The village in the rice country is far more self-supporting than in the regur country although the standard of comfort is low; the region is primarily a food producing region, commercial cropping is only subsidiary. How long it will remain so is doubtful, but it is safe to say that in view of the dense population and the character of cultivation it must always be primarily a food producing region. It is even probable that it may be called on in the future to serve as a granary for the commercialised West which even now in some years has to import food.

The rice regions of Madras and Mysore which were the rice-ragi-groundnut-sugar cane-pulse regions, are yet further advanced than the Wainganga rice region. Groundnut is an important export crop, the region is being extensively opened up with roads and railways, and industry is starting in the bigger towns, yet still the village retains most of its old self-sufficiency. Its food basis, as in the other rice zones is a dual one, rice for the richer wet cultivator, and ragi for the poorer dry cultivator; ragi, in spite of the great irrigation in the region, is the staple food of the population of Mysore. Sugar cane and groundnut with rice are the typical crops on the wet lands. The high population density in Mysore, and the developing communications, are hopeful for the groundnut crop. On account of the great outlay it is as yet the crop only of the richer cultivator. The crop is absent from the poorer rugged lands of the Malnad to the west where neither labour nor soil permits of its growth. Sugar cane growing prohibits the introduction of western machinery as in Bombay, by the smallness of the holdings; sugar is still produced uneconomically in the crude native form of "gul."

A typical Mysore village is described by Slater;[1] the village possesses both wet and dry land which is in the following proportions:—

Kind of Land.	*Acres.*
Wet land	141.3
Dry land	304.29
Land watered by wells	52.19
Common waste	451.35
Pastures other than waste (woods and forests)	898.14

The small proportion of irrigated land even in a wet village is apparent, but the enormous value of the wet land as compared with the dry land is obvious from the assessment figures.

Wet lands.		*Dry lands.*	
Rates.	*Acres.*	*Rates.*	*Acres.*
Rs. 4.	18.38	Rs. 1.	304.29
Rs. 5.	32.38		
Rs. 6.	21.24		
Rs. 7.	20.35		
Rs. 8.	7.37		
Rs. 9.	1.1		

[1] Some South Indian Villages. G. Slater. University of Madras Economic Series.

The irrigated land is watered by two tanks which hold water for two crops, and there are 14 small wells. The greater value of the wet lands lies partly in the fact that they produce a more valuable crop, but also in that they can produce two crops a year where dry land produces only one. Rice occupies about 81 per cent. of the wet lands while ragi occupies 56 per cent. of the dry area.

The fuel and fodder basis of the village is strikingly different from that of a regur village ; both pasture and woodland are available for the cattle to graze, and supplementary fodder is given, such as grain husk or oil cake. Fuel being available, the village uses 90 per cent. of its cattle dung for manure instead of as in the regur villages for fuel.

The population of the village is engaged in agriculture and subsidiary industries. The great demand for labour on the gold fields of Kolar, or in the silk weaving and cotton factories of Bangalore and Mysore and the coffee plantations of the West, is not supplied primarily by the agricultural population of Mysore. Much of it is imported from the Madras rice plains, or from the Kanara districts of Bombay.

The region is the most progressive of the Deccan rice lands as reflected in the development of industry and the progress of the co-operative movement, but it is questionable whether commercial cropping can ever extend in the region to the same extent as in the regur zone. Sugar cane and groundnut seem the only possibilities, and sugar cane is definitely a crop needed for home consumption. The enormous population also requires that the land should be kept primarily for food production. The standard of comfort is very low, and agricultural improvement should be directed not to the introduction of commercial crops, but to the improvement of cultivation of the native food crops.

C.—RURAL ECONOMY OF THE COFFEE ZONE.

The rural economy of this zone presents features entirely at variance with those of the rest of the Deccan. The region, prior to the introduction of coffee was one of ordinary villages, scattered and small owing to the rugged forested nature of the country, and growing crops of rice, sugar cane, areca nut, and betel leaf ; no communications touched them, they were entirely self-sufficing. Coffee cultivation was introduced to the region in the mid 18th century, and the influence on the rural economy of the region has been great, the dominating fact being that the majority of the coffee estates are owned and run by Europeans and worked with native labour, a state of affairs found nowhere else on the Deccan. When it was found that coffee was a profitable industry, both natives and Europeans turned mainly to its cultivation, the Government making large grants of land in the jungle for the purpose. Thus there existed side by side the two extremes of agricultural production, the small native proprietor growing his rice crop and a few coffee trees on his tiny holding in a very crude manner, and the large European proprietor running his big estate with native labour and up-to-date scientific cultivation, far in advance of the native. The features of Coorg are typical of the coffee regions.[1]

Coffee planting is the main industry of Coorg ; there are 94 estates, of which 83 are owned by Europeans. The result in the region is, therefore—a big class of landed proprietors, a big class of landless labourers, and a big class of small proprietors.

1 Figures from Census. Coorg. 1911.

The influence of the introduction of coffee into Coorg has been questioned as a bane or a blessing to the native population. The crop at first provided a ready means of making money, and was taken up by native and European alike, to the detriment, in the former case, of the old rice crop. The native, with more money at hand, adopted a higher scale of living, and became less thrifty and temperate. But the coffee boom did not last ; the introduction of cheap Brazilian coffee into the world market and the ravages of the borer, rapidly brought down prices, and the native population was reduced to a chronic state of indebtedness to maintain its old style of living. Gradually the cultivation of coffee lost both its value and its interest to the native, and, though he still kept his few coffee trees, he devoted himself once more mainly to the cultivation of rice. The figures of rice acreage in Coorg 1901-1911 show the influence of the decline in coffee production.

1901.	.1911
79930 acres.	82502 acres.

The numbers of ordinary cultivators as contrasted with the growers of special products (of which coffee is classed as one in the census reports) increased by 2,600 between 1901 and 1911. Yet in spite of the drop in the native cultivation of coffee, the plantations are still the main basis of prosperity in Coorg, though the total area has shown a decrease for some years past.[1] The influence of this industry on the population is very clearly brought out by the Census returns which show curious fluctuations from decade to decade, and the apparent anomaly of increased house building to accommodate a decreasing population. The explanation lies in the mobility of labour. The labourers on the coffee estates arrive about July, and return to their own affairs and crops about September. In November there is a fresh influx which does not ebb till the harvest is gathered in February, March and April, so that the population figures vary considerably at different periods of the year. The population of Mysore is not sufficient to supply the big labour demand both of her industries and her coffee plantations, and there is a large immigration from the neighbouring parts of Bombay and Madras.

The Nilgiris show perhaps better than anywhere the European planter supreme. It is essentially an English region, and the fact is reflected in the very large number of plantation owners, who, out of a total population supported by agriculture of 75,575, number 40,509, and the labouring population which numbers 22,874. These two classes thus comprise the largest proportion of the population, almost 84 per cent. The fact is further reflected in the size of the villages. Of the total number of 57 towns and villages in the region, only 10 are under 500, while there are 19 of 1,000 to 2,000 population and 17 over 2,000.[2] The figures are remarkable for such a small region as compared with the general Deccan conditions, and show the enormous influence which the plantation system has wrought on the old type of native economy.

The smaller cultivator now does better to confine himself to rice, and smaller crops like pepper, betel leaf, or areca nut, which are the natural products of the region and which are very profitable to cultivate. They provide also valuable side lines for the big coffee cultivator.

The coffee region, though small, has shown perhaps better than any other part of the Deccan what an enormous influence the production of a region exerts on its economy. The plantation system which is peculiar to the region,

1 1901. 58398. 1903. 51445. 1905. 47657. 1907. 45414. 1909. 42773.
1902. 53147. 1904. 47720. 1906. 45108. 1908. 43585. 1910. 43636.
2 Figures from Provincial Census Returns. Madras 1911.

can here be pursued not only because of the character of the crop, but because of the vast stretches of uncultivated jungle land, and the scanty native population ; nowhere else on the Deccan would it be possible. The system might, probably would, be beneficial to commercial cropping on the Deccan, particularly of cotton, but it has been rightly realised that the land of the Deccan belongs to the native, and the requirements of commercial production must not be allowed to rob the native of his rightful property. The only course that can be adopted, is to educate and assist him to grow a commercial crop successfully as far as his land will permit, without detriment to his food supply.

IV.—DISTRIBUTION OF POPULATION ON THE DECCAN WITH REFERENCE TO THE PRODUCTION ASSOCIATIONS (Fig. 28).

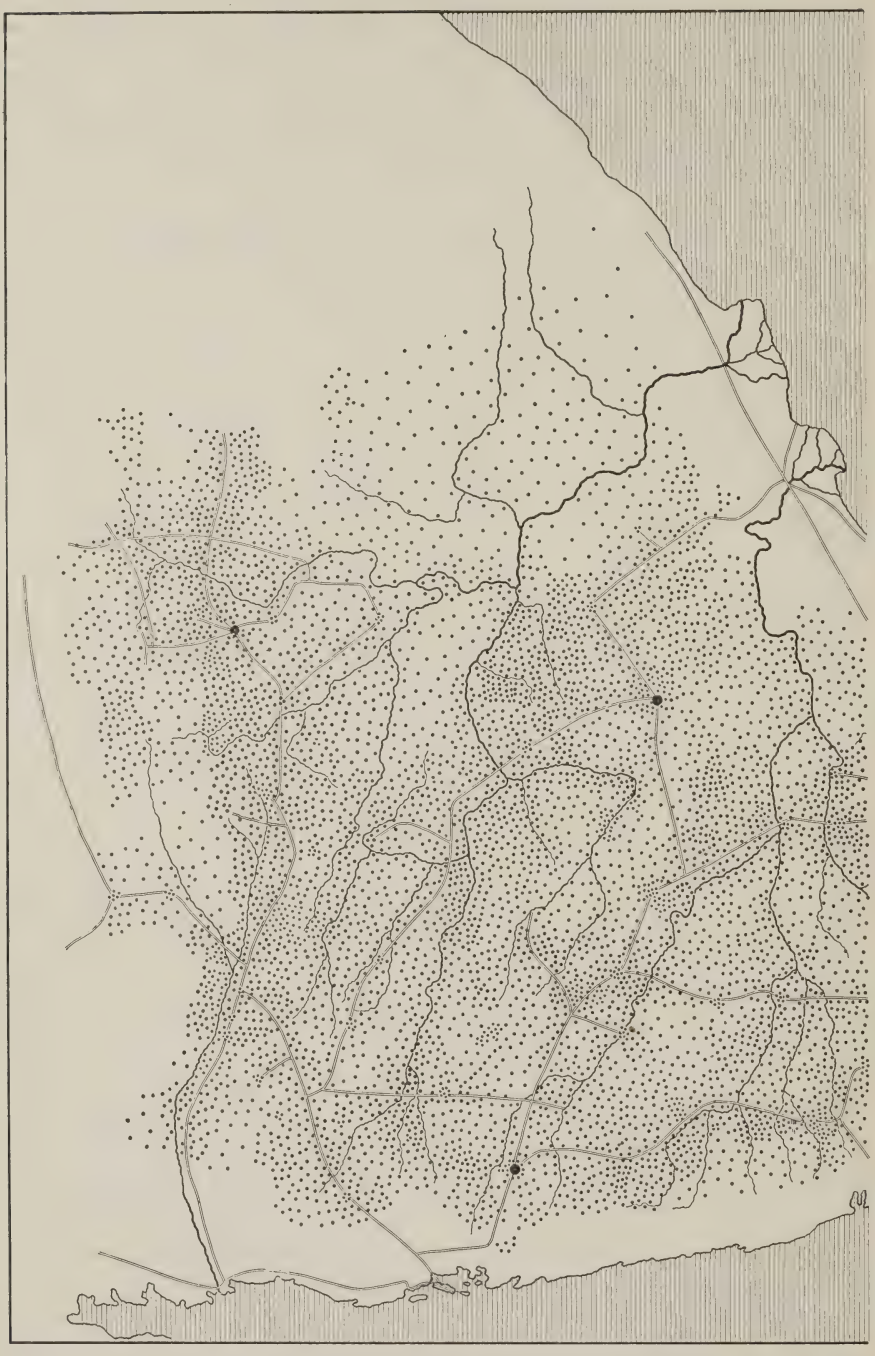
The distribution of population on the Deccan is necessarily the result of all the factors, physical, economic and social, so far discussed.[1] Fig. 28 attempts to show the population distribution in relation to the railways which symbolise the introduced western influences, and the river valleys which symbolise the natural physical influences. An analysis of the map shows that population throughout is dense but there is definite concentration along the river valleys and fertile tracts, along the railways and around the towns, and in the irrigated districts, which, being primarily rice land, are food growing.

In the first big production zone along the fertile valleys of the Tapti and Purna, and the plains of Berar and Nagpur (which is the jowar-cotton-wheat-linseed-pulse zone) where both food and commercial cropping are extensive, there is decided concentration of population, the density per square mile reaching to 300 in parts of Khandesh and Nagpur. Apart from the good agricultural basis of the region, its advantages are enhanced by the railway facilities which are essential for a commercially cropped region. The belt is traversed from east to west by rail, and has branches both south west to Bombay, and north to the Narbada and Ganges valleys. This zone of dense population extends eastwards from the black soil regions to the Wainganga valley. Concentration here is due primarily to the good soil and rainfall basis, and to irrigation facilities, which make it one of the greatest rice producing regions of the Deccan, and to the fact that it is traversed by rail both north, south, east and west, along which railways population shows definite concentration. A feature of the regur portion of the east-west belt, as contrasted with the rice portion is the frequent occurrence of towns along the railway. This is due to the character of production in the region, which, being primarily commercial, necessitates central markets to which the cultivator may bring his crop so that it may be sent to the port for export, which for all this region is Bombay. The influence is further reflected in the size of the villages, which tend either to be very small or very large, these latter being the collecting or ginning centres for the commercial crops. In Amraoti, as typical, of the area 75 per cent. of the villages are very small with a population under 500, while 17 per cent. are of large size having over 1,000 in population.

In Bhandara as typical of the rice country 69 per cent. of the villages have under 500, but 25 per cent. have between 500 and 1,000, only 6 per cent. having over 1,000.

South of this east-west belt of population there is a belt of much thinner population also extending across the country from east to west. In the west

1 The basis of the Map is the Provincial Census Report 1911, and the figures used are those for the taluks within the administrative districts of each state.



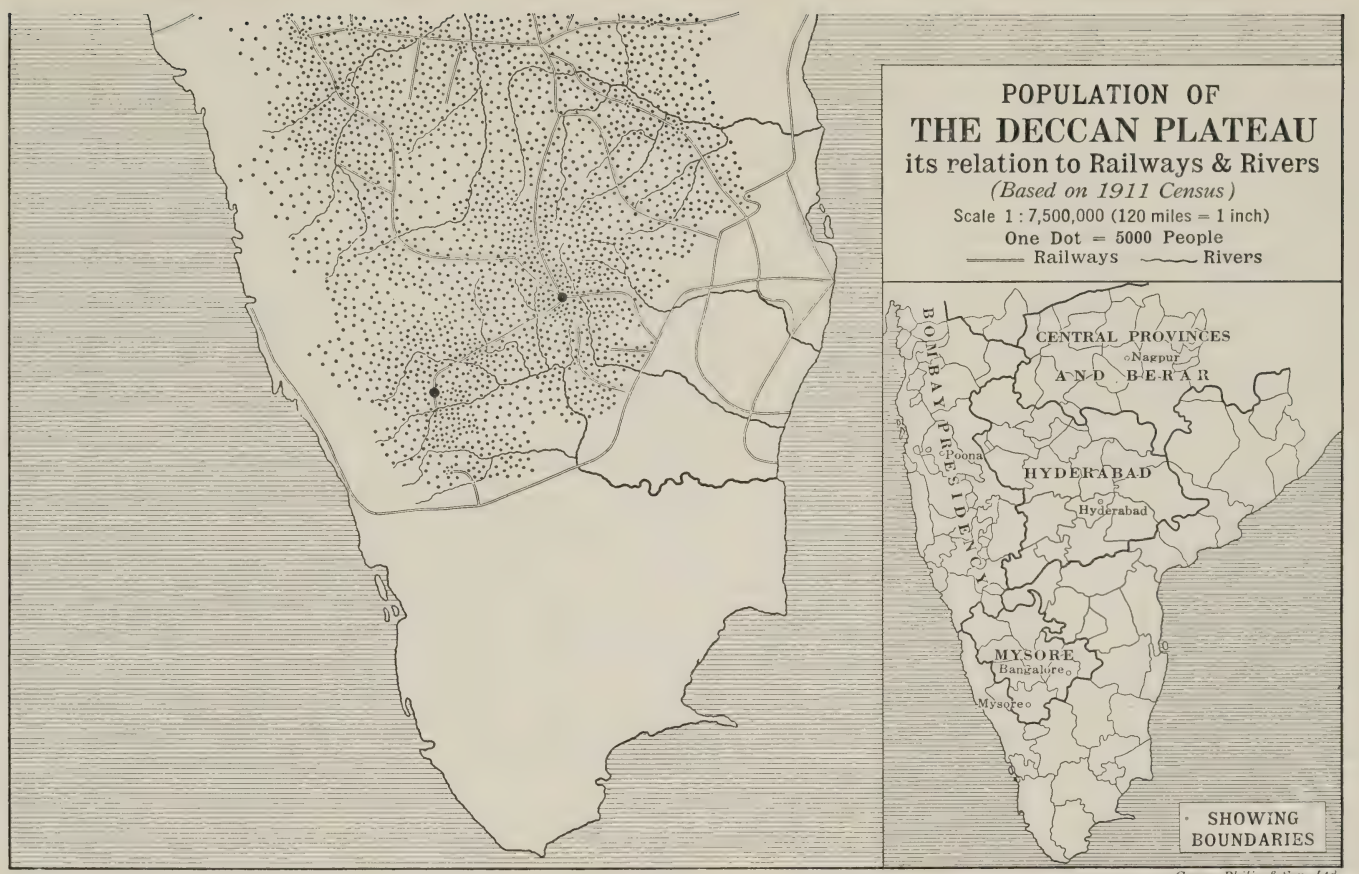

POPULATION OF
THE DECCAN PLATEAU
its relation to Railways & Rivers
(Based on 1911 Census)
Scale 1 : 7,500,000 (120 miles = 1 inch)
One Dot = 5000 People
Railways
Rivers
CENTRAL PROVINCES
AND BERAR
Nagpur
BOMBAY PRESIDENCY
Poona
HYDERABAD
Hyderabad
MYSORE
Bangalore
Mysore
SHOWING BOUNDARIES
George Philip & Son, Ltd.

FIG. 28.

this is due to the poorer soils and uncertain rainfall of the region and its resultant poor agricultural basis. Population shows concentration along the railways and river valleys, and on the plains of Parhani and Nander in North Hyderabad where soil conditions and rainfall conditions are better. In the eastern part of the belt, the lower Godaveri valley (on the plateau) has, in spite of good rainfall, only a poor agricultural basis because of poor soils, and population is scanty showing concentration, however, in the region of Sironcha where the soils are more fertile. Further east, in Bastar and Vizagapatam the rugged forested highlands are only scantily populated by backward tribes. To the south of this belt there is a zone of concentration running in a north-west-south-east direction, comprising in the west a narrow strip along the Godaveri valley, and widening out eastwards to the Telingana rice country of Hyderabad. In the west, the zone widens a little on the plains of Kopergaon, in Western Nasik, but narrows to a belt along the course of the Godaveri; it widens again on the plains of Parbhani and Nander in Northern Hyderabad where soil and rainfall conditions are more favourable to agriculture, and where the railway from Bombay, through Nasik to Hyderabad approaches the river, thus giving a double cause for concentration. In the Telingana to the east the zone widens, and density is great throughout, showing however definite concentration along the river valleys. The root cause for this denser population is that the region is a food producing and not a commercial producing region as are the Marathwara regur lands of the west. Perhaps in no other region of the Deccan is the influence of food and commercial cropping on population more clearly shown than in the Eastern Telingana and the Western Marathwara of Hyderabad.

In the Marathwara the proportion of cultivated to total area is 68·6, while in the Telingana it is only 38·8 and yet the population density in the former is only 234·7 per sq. mile, as compared with 420·1 in the latter. The figures are striking, and that the determining factor is rice growing is proved by the figures within the Telingana, which show that where rice cultivation, otherwise irrigation, is most intense, there population is densest. Given a rainfall of not less than 30ins. per annum, the population which a given area can support is conditioned by the extent of it under rice and irrigation."[1] The two districts most intensely irrigated, Medak and Atrafi Balda, show the highest density of population per square mile, 566·15 and 550·13 respectively. The highest density for the very richest parts of the regur lands of the Tapti valley is only about 300. The low population density of the Marathwara is probably due to the extent to which it is commercially cropped, and to the very uncertain rainfall of the region. The census report shows further that its population is not increasing to the same extent as in the Telingana probably owing to the same causes. A further interesting comparison lies in the size of the villages. The commercially cropped western region tends to have a very large proportion of small villages, and a good number of large ones. The rice country on the other hand shows a tendency to a more uniformly intermediate size of village; its average population per village is about 644, as compared with 548 in the Marathwara. The larger size is probably due both to pressure of population and to the necessity of concentration for irrigation facilities. South of this north-west-south-east zone, in the region comprising the East Bombay Deccan, the southern and western parts of Hyderabad and the Madras Deccan, which formed the jowar-cotton-bajri-pulse zone, population shows only a moderate density as compared with Eastern Hyderabad. Several factors account for this. The first is rainfall, which in this region is more scanty and precarious than anywhere else on the peninsula, and as a result, famine is frequent. This, together with malaria, is continually carrying off thousands of the population. That fear of famine is

1 Provincial Census Report. Hyderabad 1911.

a powerful influence in population distribution is shown by the remarkable concentration along the railways in this region. The line running from Poona, south east through Sholapur, Gulbarga and Raichur, to Madras and Mysore, shows this fact well, particularly in Raichur and Gulbarga, where the soils are poor and rainfall not good. The concentration is enhanced here, in that the railway runs almost parallel to the Bhima river down to its junction with the Kistna, and population has concentrated along this valley as well as along the railway. To the east of this belt, in the Lower Kistna valley, poor soils and lack of communications result in scanty population. To the south-west of it, a belt of moderate concentration is apparent along the course of the Upper Kistna in the south of the Bombay Deccan, and in the fertile valley of the Dhon in Bijapur. Along the West Bombay Deccan population is on the whole denser than in the East Bombay Deccan, in spite of less favourable soil conditions. The fact reflects the paramount importance of rainfall to an agricultural population. This is the bajri-pulse-groundnut and garden cultivation zone, and the advantages of good rainfall, irrigation and rail communication, is apparent from north to south of the region through Poona, Belgaum and Dharwar. It reaches its greatest density in Belgaum where good rainfall conditions with a resultant good agricultural basis prevail.

On the Madras Deccan, in spite of an uncertain rainfall, the good retentive soils and well developed rail communications have resulted in more concentration than on the East Bombay Deccan. Population tends to follow both the Kistna and Tunghabhadra river valleys and the railways.

To the east of the Madras Deccan a zone of moderate concentration is apparent along the Nandyal and Penner valleys of Kurnool and Cuddapah, where soil and rainfall are good and irrigation facilities available. Further to the east the rugged land of the Eastern Ghats is not densely populated.

The final region, the Mysore plateau, has two main divisions ; the richer Maidan in the centre and east, and the poorer Malnad in the west. The division is well borne out by the population distribution. The Maidan shows a very dense population, owing to its good food basis of rice and ragi, and its good communications. Two main nuclei of population stand out, at Mysore and at Bangalore. The density in Mysore is due to the favourable nature of the soils here ; the region is flatter than most of the plateau, and the rainfall is good. It is also a highly irrigated rice growing tract. The very dense population round Bangalore can be attributed also to the good soil and rainfall conditions and good food supply, and to the fact that it is the focal point of five railways, south-west to Mysore, north-west to Dharwar, north to Anantapur, and two lines south-east to Madras. These lines radiate from Bangalore like spokes of a wheel, and population very definitely is related to them.

In the Malnad tracts population is considerably less dense owing to the rugged nature of the country and its poor soils. Not only is population scanty, but it is very scattered ; it is not so definitely concentrated into village form as on the Maidan, but is composed of numerous small groups which could hardly be termed villages. The region further lacks communications. The influence of the better soils, better irrigation, and rail communication is very noticeable in north-eastern Shimoga where concentration of population is very definite, and continues along the railway line to Dharwar.

The belts of scanty population in the Maidan are the result of rugged uplands, typical of which is the tract between the Hagari and Varada rivers in Chitaldrug. The extreme scantiness of population here is also probably

related to the fact that it comes within the dry core of the Peninsula with an annual rainfall below 20ins.

The progressive nature of the Maidan as compared with the Malnad is reflected in the town figures; in the Maidan there are 601 towns and villages with a population over 1,000, while in the Malnad there are only 131.

Taking the whole of population distribution on the Deccan it cannot but strike one that the influence of rice growing is a very vital one. The soils of the rice regions are neither so extensive nor so rich as those of the regur lands, yet, because they are for the most part regions of more certain rainfall and irrigation facilities, and most important of all, are regions of food growing as compared with commercial production, they show a far greater density of population as a whole than the regur lands as a whole.

CONCLUSION.

NECESSITY AND SCOPE FOR IMPROVEMENT OF INDIAN AGRICULTURE.

The study of population distribution has shown that the main factor underlying Deccan life is food availability. Population concentrates in the fertile food producing areas, or, where soils are poor and rainfall uncertain, along the railways where food will be available in famine time. This enormous influence of food on population distribution gives the key to the significance of the whole of Deccan agriculture; its prime function is now and must always be, the feeding of its myriads of people. Commercial cropping will progress, already it has greatly benefitted the ryot, but the care for the future must be that the area under commercial crops shall not be extended at the expense of the food area. The influence of commercial cropping on the distribution of population has already been pointed out in the Maratha and Telingana districts of Hyderabad. If the commercial area is not to be extended, and increased production is required, the remedy must be sought in the improvement of existing methods of production, a subject which has been receiving great consideration for some time past. It is held by some that the Indian ryot is too conservative a person to adopt improvements to better his cultivation, but others are of the opinion that the ryot knows his job better than the West ever dreams of; all he wants is opportunity for improvement, but it must be given in the right way. "It is assumed that the Indian cultivator knows nothing about his own business, that anything that is good must come from the West, and so the kindly, but in many cases misdirected, efforts of early workers, took the line of introducing into India crops or implements of Western origin regardless altogether in the case of crops, of the effect of climatic change, or in the case of implements, of consideration of cost. Real progress only came when it was realised that in India we have to deal with an agricultural practice which has been built up on the traditional custom of years, in which reside, though unexpressed, and unexplained, deep scientific principles."[1]

It is, therefore, the improvement of the native methods, to which the West must turn, and the combination of native skill and knowledge, which centuries of practice alone can give, and Western science, may in the future make India what she hopes to be, a land growing sufficient to support her large population at a decent standard of comfort, and with a surplus of produce for export as a source of income for her national expenses.

1 J. R. Mackenna. "Agriculture in India. 1915."